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AIR WAR COLLEGE  
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STRATEGY FOR AIRCRAFT MAINTENANCE  
IN THE PACIFIC

by

Dennis G. Haines  
Colonel, USAF

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A RESEARCH REPORT SUBMITTED TO THE FACULTY  
IN  
FULFILLMENT OF THE RESEARCH  
REQUIREMENT

Research Advisor: Colonel John Brantner

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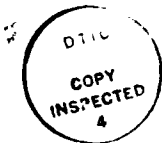
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## AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: Strategy for Aircraft Maintenance in the Pacific

AUTHOR: Dennis G. Haines, Colonel, USAF

Introductory remarks describe the Pacific Air Force in terms of its current force posture and its current logistics support structure. It provides a brief historical view of the evolution of the Centralized Intermediate Logistics System concept, from its roots in General Kenney's Far East Air Force of World War II, to the present. Following a brief description of the PACAF Centralized Intermediate Logistics System, it analyzes the system in terms of its vulnerability, its responsiveness, and its relative efficiency. Based on an assessment of the Soviet threat, potential interruptions of the repair pipeline due to over-tasked airlift, and efficiencies of decentralized operations, it recommends that intermediate repair be returned to the wings. This recommendation is followed by an analysis of the costs associated with closing the PACAF logistics Support Center and re-establishing repair capability in the wings. The conclusions of this study strongly support the need for a Pacific Distribution System, the continued operation of AFLC's Support Center Pacific, and increased use of in-theater industrial capability.

## BIOGRAPHICAL SKETCH

Colonel Dennis G. Haines (M.B.A. University of Wyoming, 1969) has a broad logistics background with extensive experience in the Pacific. He began his career as a supply officer, where he held various base level jobs. He received his first PACAF experience in 1972, as the Maintenance Control Officer for the 19th Tactical Air Support Squadron, Osan AB, Korea. In 1973, he was assigned to HQ Air Defense Command where he participated in concept development for the Production Oriented Maintenance Organization. Colonel Haines then transitioned into aircraft maintenance, and was assigned to the 1st Tactical Fighter Wing, Langley AFB, Virginia, where he gained extensive flightline maintenance experience, and participated in several overseas deployments. Colonel Haines then returned to the Pacific, where he served as the AGS Maintenance Supervisor, Maintenance Control Officer, and Equipment Maintenance Squadron Commander for the 18th Tactical Fighter Wing, Okinawa Japan. He served as the Director of Maintenance Engineering, HQ PACAF prior to attending the Air War College. Colonel Haines is a graduate of resident courses at the Squadron Officers School, Armed Forces Staff College and the Air War College, Class of 1988. He was designated an Air Force Outstanding Supply Officer for 1972, and was the first recipient of the Air Force's General Lew Allen trophy in 1983.

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## CHAPTER I

### INTRODUCTION

The significant test of any aircraft maintenance organization is its ability to supply mission ready aircraft and to sustain high sortie rates in combat. Criteria are stringent, because the task is demanding. The unit must be prepared to mobilize rapidly and go into combat with little or no warning. It must be flexible and responsive, able to absorb attacks, recover, and continue to generate aircraft. The United States has had little experience with operating airfields while under attack, and too often leaders ignore the effect that Clausewitz terms as friction. The "countless minor incidents -- the kind you can never really foresee [which] combine to lower the general level of performance, so that one always falls far short of the intended goal" (13:119).

The "Salty Demo" exercise, conducted in 1985, in which Spangdahlem Air Base was subjected to a simulated air strike, demonstrated that we were largely unprepared mentally and organizationally for the uncertainty and "friction" that was generated when an airbase was attacked, people killed, and vital facilities and equipment damaged or destroyed (39). Two studies looked at this problem. Under PROJECT AIR FORCE, the Rand Corporation study titled,

Enhancing the Integration and Responsiveness of the Logistics Support System to Meet Wartime and Peacetime Uncertainties, found the current logistics structure unable to respond adequately to highly variable demand rates for aircraft spares even if production capability, such as avionics intermediate test stations (AIS), remained undamaged (58:1). Under the sponsorship of the Directorate of Logistics Plans and Programs, HQ USAF, the Air Force Logistics Management Center conducted "Project RELOOK". The project concluded that, in the European theater, air bases would be under attack from air and ground forces within the early hours of the conflict, and would be repeatedly attacked thereafter (39:4). The study concluded that, in this environment, successful logistics support depended on maximum base self sufficiency (39:5). The study stressed that decentralized, flexible leadership, and cohesive, well-trained forces were required in order to minimize the effect of "friction".

The long, over water lines of communication in the Pacific offer an additional challenge. It is 9000 miles from Kadena Air Base on Okinawa, Japan to its primary logistics support center at Warner-Robins Air Force Base, Georgia. From the West coast of the United States to the headquarters of the Pacific Air Forces (PACAF) in Hawaii is over 2300 miles, and from Hawaii to the nearest base, Yokota



Air Base Japan another 3850 miles. Distances between bases are also long. It is 2150 miles from Clark Air Base in the Philippines to Misawa Air Base in Northern Japan, and 1600 miles from Clark to Osan Air Base, Korea. Except in Korea, there are no land lines of communication connecting the bases. Therefore, uninterrupted air resupply is essential to sustained combat operations (Figure 1).

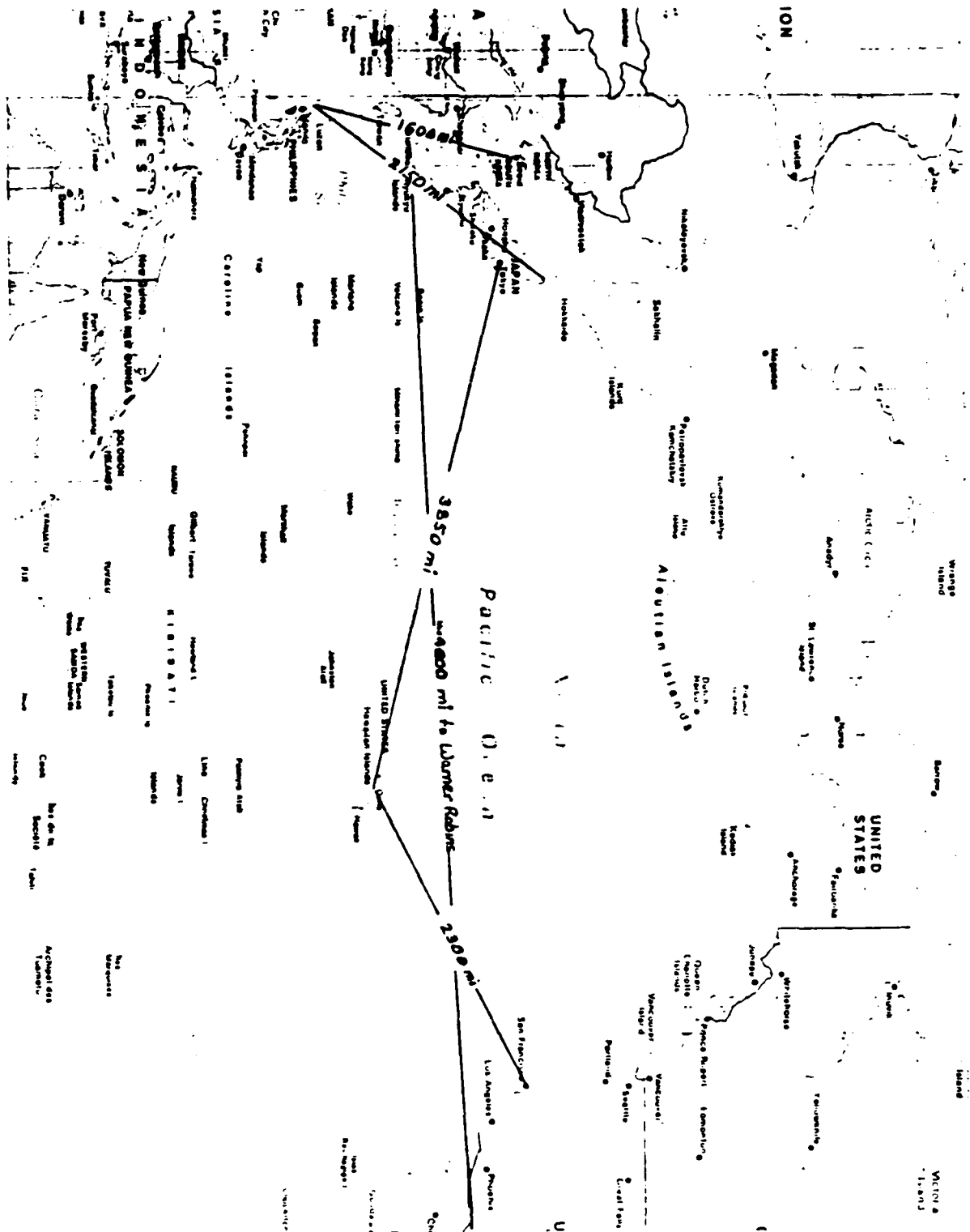
#### Centralized Intermediate Logistics System

PACAF designed the Centralized Intermediate Logistics System (CILS), because of the threat to forward bases. The CILS centers on the concept of light, highly mobile, highly capable forward units supported by a technologically sophisticated, highly responsive intermediate level repair center located in a safe area in the rear. Kadena air base offered an ideal location for the repair center. The base was in the relative center of the theater, was safe from threat in the event of a North Korean attack on the Republic of Korea, and was within unrefueled C130 range to any other PACAF base in the Western Pacific.

The CILS consists of: (1) a repair center, now known as the PACAF Logistics Support Center (PLSC), which is manned and equipped with resources withdrawn from supported units; (2) a supply function which monitors supply status and makes allocation decisions among units; and a regularly scheduled airlift channel. The PLSC is responsible for

FIGURE 1

PACAF LINES OF COMMUNICATION



intermediate level maintenance and inspection of aircraft engines, avionics and selected electric and hydraulic components. The Center's supply division is responsible for ordering, tracking and storing parts for the PLSC repair operation, and for making allocation decisions when shipping parts to the units (42:77).

The Military Airlift Command (MAC) provides a regular scheduled airlift to each PACAF base six days a week. When the airlift channel was originally established, PLSC cargo was given priority and moved ahead of everything else (46:1). This is no longer the case, and cargo moves on a first-in, first-out basis in which PLSC parts receive equal priority with other cargo moving through the system.

Need For Study.

During its ten years of operation, the CILS has effectively supported PACAF fighter units. The Pacific Air Forces have achieved improvements in aircraft mission capable rates and aircraft utilization rates which have tracked with those of the Tactical Air Command (TAC) and United States Air Forces Europe (USAFE) (49:121). In some commodities, most notably aircraft engines, serviceability rates exceeded those of either command.

Since 1980, however, the factors which led to the formation of CILS have changed markedly. First, Soviet power projection capability has improved substantially, putting at

risk the "safe-haven" concept which allowed total theater repair of aircraft engine and avionics components to be centralized at one location. Second, the composition of forces has changed dramatically. PACAF is no longer an F4 command. Newer generation F-15 and F-16 aircraft now constitute over 60% of the fleet and programmed conversions will increase this further. Finally, recent organizational studies have called into question the efficiency of centralized operations.

These changes require a re-evaluation of the validity of the CILS concept. Many studies have been conducted to determine the optimum maintenance structure, and they have reached widely varying conclusions. A Rand study titled CLOUT, Coupling Logistics to Operations to Meet Uncertainties and the Threat, argues for a PACAF style consolidation (58). The Air Force Logistics Management Center's "Project RELOOK Phase IV Report" argues for self-sufficiency (39). PACAF has conducted its own study and is now in the process of moving the PACAF Logistics Support Center's repair functions back to the wings. In the midst of this confusion, combat enhancements such as the Pacific Distribution System (PDS) and Air Force Logistic Command's Support Center Pacific (SCP) are in danger of being lost.

The purpose of this study is to develop a recommended aircraft maintenance strategy for the Pacific.

The strategy must support units in combat which are capable of responding with a very short warning period, deploying rapidly over long distances, operating out of make-shift facilities, and generating high sortie rates, sometimes from bases under attack. The study considers unique aspects of the Pacific theater and evaluates alternative organizations and support structures in relation to their contribution to combat requirements for survivability, flexibility, mobility, sustainability, and productivity.

## CHAPTER II

### PACAF TODAY

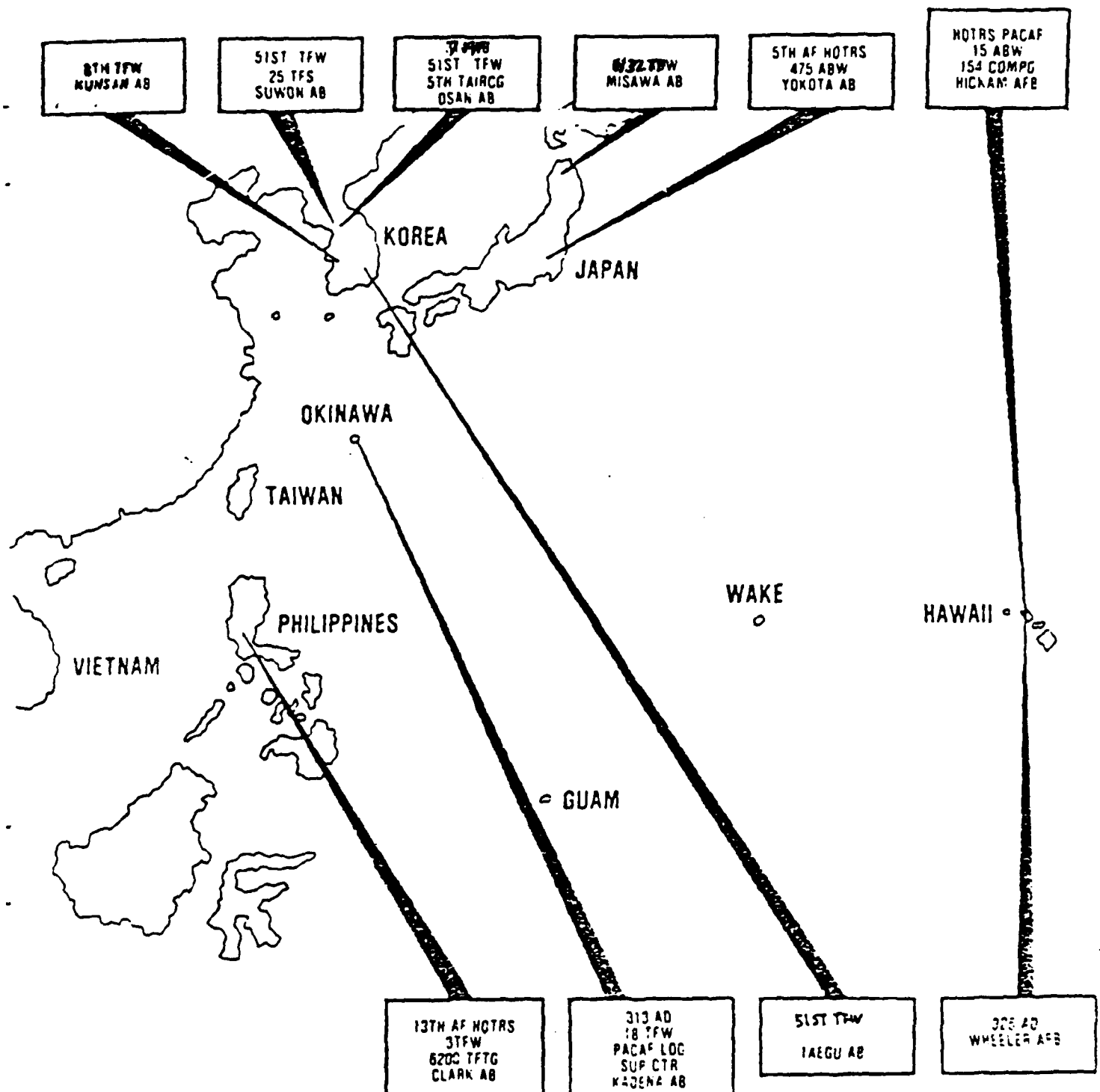
#### Introduction.

PACAF is the major Air Force command in the Pacific. CINCPACAF is designated the Air Force Component Commander for CINCPAC. In this capacity, PACAF has responsibility for a theater of operations that stretches from the West coast of the United States to the East coast of Africa. In spite of the vast area of responsibility which covers two-thirds of the globe, PACAF forces are concentrated in a relatively small area consisting of the Philippines, Japan, and Korea.

#### Force Structure and Disposition.

In peacetime PACAF is organized into three numbered air forces, two air divisions, and five tactical fighter wings (Figure 2). Fifth Air Force, located at Yokota Air Base, is responsible for the defense of Japan, and for coordinating joint Japanese-U.S. air operations. Fifth Air Force has command of two U.S. tactical fighter wings. The 432nd TFW, located at Misawa Air Base in the Northern portion of the Japanese main island of Honshu, has two squadrons of F-16C aircraft. The 18th TFW, at Kadena Air Base, Okinawa, has three squadrons of F-15C air superiority fighters, and one squadron of RF-4C reconnaissance

FIGURE 2 - PACAF UNIT DISPOSITION



aircraft that are dual based at Kadena and at Osan Air Base in Korea.

Thirteenth Air Force at Clark Air Base, Philippines, is responsible for the Philippines and Southeast Asia. The 3rd TFW is the fighting component of 13th AF. The 3rd has one squadron of F-4Es and one "wild weasel" squadron consisting of 12 F-4Es and 12 F-4Gs. The 3rd TFW also has 12 F-5Es assigned for "aggressor" air-to-air combat tactics training. The 6200th Tactical Fighter Training Group is responsible for the COPE THUNDER exercises and the Crow Valley range complex where those exercises are conducted. COPE THUNDER, similar to TAC's RED FLAG, is designed to give aircrews realistic combat training in a multi-threat environment.

Seventh Air Force commands the U.S. Air Forces in Korea. The 51st TFW is a composite wing consisting of 12 F-4Es and 14 OV-10s at Osan, 24 A-10s at Suwon, and 12 F-4Es at Taegu. The 8th TFW at Kunsan AB has two squadrons of F-16Cs. Force changes which have been announced call for the conversion of the F-4Es at Osan and Taegu to F-16Cs beginning in 1989.

#### Daily Operations.

PACAF fighter units fly a relatively heavy peacetime training schedule. Units have a heavy exercise schedule and routinely deploy 6 to 24 aircraft for exercises



such as COPE THUNDER, in the Philippines, KANGAROO, in Australia, COPE NORTH, in Japan, and COBRA GOLD, in Thailand. Aircrews and maintenance personnel get realistic training in mobility and combat operations as well as gaining familiarity with the areas in which they may have to operate.

Units fly an average of one sortie on each of their assigned aircraft each day. This equates to an average utilization rate on each aircraft of 21 sorties per month. Units typically dedicate 2/3 of their aircraft to flying each day, with the remaining 1/3 scheduled for maintenance or ground training. PACAF has gone to a basic two-go day for its daily flying schedule, meaning each aircraft on the schedule will fly two missions with an average duration between 1 and 1.5 hours.

#### Mission Capable Rates.

Mission capable rates averaged 84% for 1987. Of the 16% aircraft not mission capable, 10% require only maintenance and 6% require some part that is not available on the base (49). It is common practice to cannibalize parts from one non-mission-capable aircraft to repair another aircraft. PACAF rates ranged from 3.8 cannibalizations per 100 sorties for the F-4E to 15.1 cannibalizations per 100 sorties for the F-15C. Units cannibalize to keep readiness rates high, but cannibalization is not desirable.

Cannibalization doubles the maintenance workload, and creates the potential for damaging the aircraft from which the part is removed. PACAF uses 3600 man-hours a month or about 2% of the available flightline maintenance manpower for cannibalization (52:A6).

#### Maintenance Structure.

PACAF's wing maintenance structure is a modification to the standard Combat Maintenance Organization (COMO) adopted by the tactical air forces. It consists of three squadrons, The Aircraft Generation Squadron, the Component Repair Squadron, and the Equipment Maintenance Squadron (Figure 3).

### **COMBAT ORIENTED MAINTENANCE ORGANIZATION (COMO)**

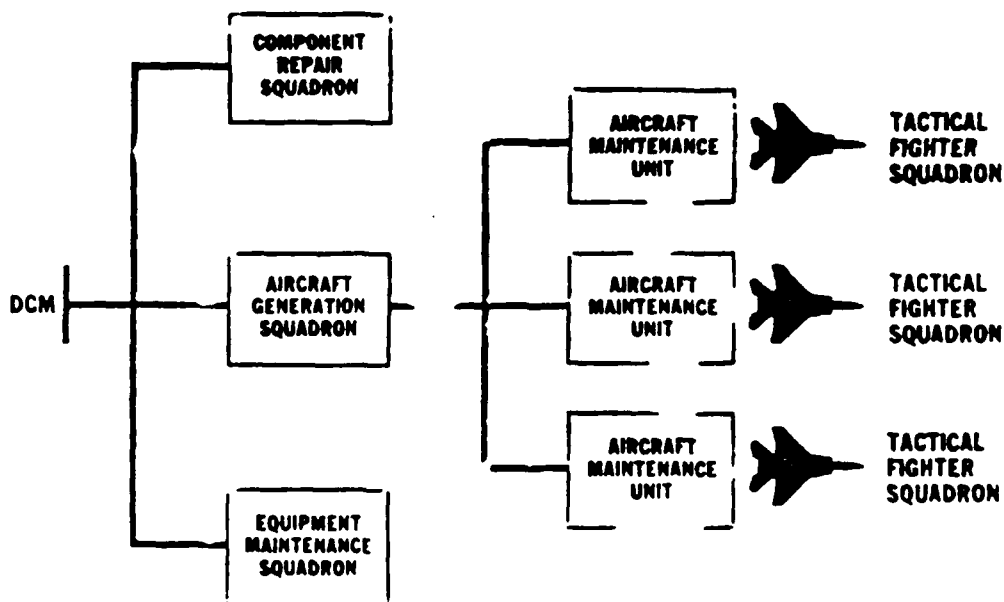


Figure 3 -- PACAF Wing Maintenance Structure

The Aircraft Generation Squadron (AGS) has the crew chiefs and maintenance technicians necessary to generate sorties and repair aircraft on the flightline. The AGS is further divided into Aircraft Maintenance Units (AMUs) which are responsible for one squadron of aircraft. The AMU is aligned with the fighter squadron that flies those aircraft. The AMU-Squadron team is expected to program, plan, and execute their flying program as a team.

The Equipment Maintenance Squadron (EMS) is responsible for the heavy industrial type of intermediate maintenance. Munitions storage, metal fabrication, corrosion control, and major aircraft inspections are performed by EMS.

The Component Repair Squadron is much smaller in PACAF than in USAFE or TAC, because many of the intermediate maintenance activities normally performed by CRS have been transferred to the PACAF Logistics Support Center. The CRS is typically responsible for aircraft fuel cell repair, egress systems, and residual hydraulic, electric, and avionics work.

The main difference between the PACAF maintenance structure and that of TAC and USAFE is the Centralization of the major portion of intermediate maintenance at the PACAF Logistics Support Center. It is essential to understand the centralized intermediate maintenance concept and

the reasons behind its formation before one can make a rational decision on the most effective structure for PACAF.

## CHAPTER III

### CENTRALIZED REPAIR CONCEPT

#### Why Centralized Repair?

The Centralized Intermediate Logistics System (CILS), was developed jointly by the Rand Corporation and the Pacific Air Forces to meet the unique conditions of the theater. It has been controversial since its inception in 1977. The removal of unit intermediate maintenance capability was opposed by the Tactical Air Command (TAC) as well as PACAF's own units.

PACAF Deputy Commanders for Maintenance argued that loss of test equipment and personnel would degrade the combat capability of the unit, that air resupply was uncertain, and that no efficiencies would be realized because of the additional overhead needed to manage the repair center and its associated supply complex. In addition, they argued, more spares would be required to fill transportation pipelines between the Centralized Intermediate Repair Facility (CIRF now named the PACAF Logistics Support Center or PLSC) and the units.\*

Why, then, would PACAF choose to remove any maintenance capability from its forward units? There were several

---

\*Arguments are contained in a series of messages between the Deputy Commanders for Maintenance at the 51st and 3rd Tactical Fighter Wings and HQ PACAF Directorate of Maintenance Engineering during the period 1977-1979.

reasons. First was the requirement to deploy rapidly into Korea. There was insufficient in-theater airlift to move all of the PACAF units as fast as was desired, so there was pressure to reduce the size of mobility lift requirements. Second, there were doubts as to the security of air bases in South Korea if the North did launch an attack. The logistics system would be hard-pressed to replace high technology intermediate level test equipment if it had to be abandoned in a fall-back to more secure bases (46:2). Finally, like the rest of the Air Force, PACAF was faced with low mission capable rates and declining sortie rates (figure 4). They believed that part of their problem was caused by the 12

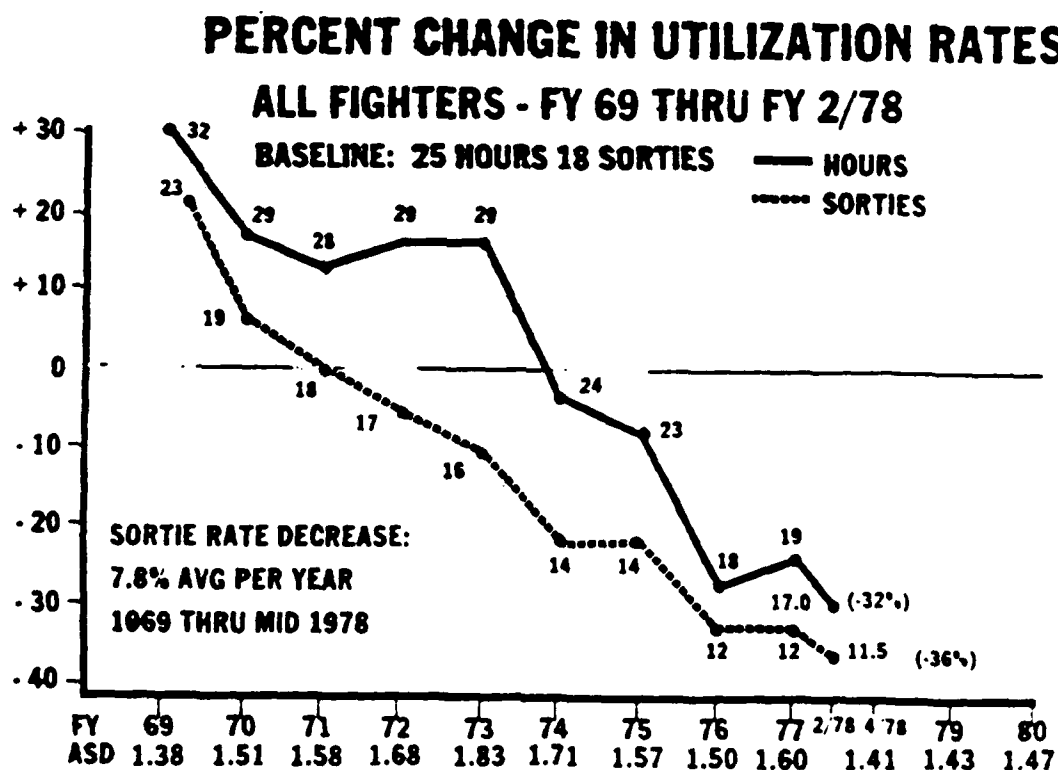


Figure 4 -- Declining Sortie Rates (45:12)  
Source: PACAF Senior Leaders Maintenance Course

month short tour in Korea, and they wanted some way to reduce the maintenance requirements in that environment.

Historical Development.

In proposing the CILS concept of light, mobile and capable forward units, supported by a maintenance facility located in the rear, PACAF was returning to a concept used by forces in the Pacific during WWII, Korea, and Vietnam. During WWII, General Kenny's Far East Air Force learned that rust, weather and austere field conditions made forward overhaul and large forward stockpiles of supplies impractical. His solution was to overhaul engines and major components in rear bases in Australia and then air lift them to forward bases. General Kenney described the benefits of this system:

"We were overhauling engines in Australia, and as the thing got off the test stand it went right into an airplane and inside of five or six hours they were putting it in a bomber in New Guinea.

Suppose, on the other hand, you do it the old fashion way, you take the silly engine off here and disassemble half of it and wrap it up in little packages, and they get lost when you open the crate. Everything is supposed to be proof against this damp tropical weather and proof against the salt spray that they get. . . . They load those boats until they have enough for a convoy. A month goes by. This thing has gotten all rusted, and the pistons won't move, and the crankshaft had red spots on it, and when you do get the cosmoline off of it you haven't an engine until two months have gone by (31:7)."

Following WWII, the fledgling United States Air Force established a logistics doctrine in which the wing was

the basic fighting unit, and it was provided the necessary maintenance resources to fight independently. In the Korean War, however, the loss of airfields and the fluid state of the battlefield mandated a return to the forward operating base concept. Only organizational level "remove and replace" maintenance was done at the forward bases. Most overhaul of aircraft and components was done in Japan and the United States (64:139). Japan offered a safe haven for storage of supplies which could be rapidly airlifted to the units in the forward bases.

Vietnam brought other lessons. Initially bases were austere and the environment faced by men, equipment, and supplies was as severe as that faced by Kenny's forces in WWII. Units were deployed with only their War Readiness Spares Kits, their mobile aerospace ground equipment (AGE), and technicians needed for on-aircraft repair. Overhaul and major repair of aircraft and components was done in the rear at main operating bases in Japan and the Philippines.

As the build-up continued, commanders complained bitterly about their lack of repair capability and the inefficiency of shuttling aircraft between forward operating bases (FOBs) and main operating bases (MOBs). They argued that it was time consuming and decreased the number of aircraft available for combat (64:159). Eventually intermediate maintenance capability was restored to the forward



bases. However, there were still strong forces arguing that central repair facilities were more economical and efficient. Vietnam became a laboratory for testing maintenance concepts. Several programs were run to test centralized repair concepts, but none improved support to the combat unit, and results were inconclusive (26:164). The Air Force emerged from Vietnam with a wing maintenance structure that was highly centralized, but largely self-sufficient.

In the late 70's there was general concern about the deteriorating quality of aircraft maintenance. Aircraft were frequently unreliable, and the percentage of aircraft that were fully mission capable had dropped. The number of sorties flown on each fighter aircraft had decreased from 23 sorties per month in 1969 to only 12 in 1977 (figure 4). The tactical air force commanders were convinced that the cause was the centralized organization structure defined by Air Force Regulation 66-1, which was formulated and implemented in the early 70's (17:23).

The AFR 66-1 organization had four squadrons and a large DCM staff. The Organizational Maintenance Squadron had the crew chiefs and ostensibly was responsible for the aircraft. The Field Maintenance Squadron, Avionics Maintenance Squadron, and the Munitions Maintenance Squadron had the technicians necessary to repair the aircraft. A DCM staff function, Job Control, had the authority to control

flightline operations, set priorities, and dispatch specialists from support squadrons to the aircraft.

Many people argued that the AFR 66-1 structure had too many built-in delays, and that responsibility, authority and resources were fragmented. The Organizational Maintenance Squadron, which ostensibly had the responsibility for the aircraft, did not have the authority to control and manage the resources needed to repair the aircraft and to generate sorties. Conversely, Job Control, which did not have the responsibility for the aircraft, had the authority to dispatch the technicians, test equipment, and ground support equipment needed to repair broken aircraft (17:23).

PACAF, along with other tactical air force commands, turned to the Production Oriented Maintenance Organization (POMO) to correct these problems. The intent of this organization was to focus on production and combat sortie generation. POMO organized manpower and resources according to the product for which they were responsible (figure 5). For example, all the crew chiefs and specialists required to work on the aircraft and to generate sorties were assigned to the Aircraft Generation Squadron and grouped into aircraft maintenance units. Each aircraft maintenance unit (AMU) was responsible for a squadron of aircraft and was aligned with the fighter squadron which would fly those aircraft. In shop repair of components and major overhaul and

## FIRST STEP -- 66-1 TO POMO

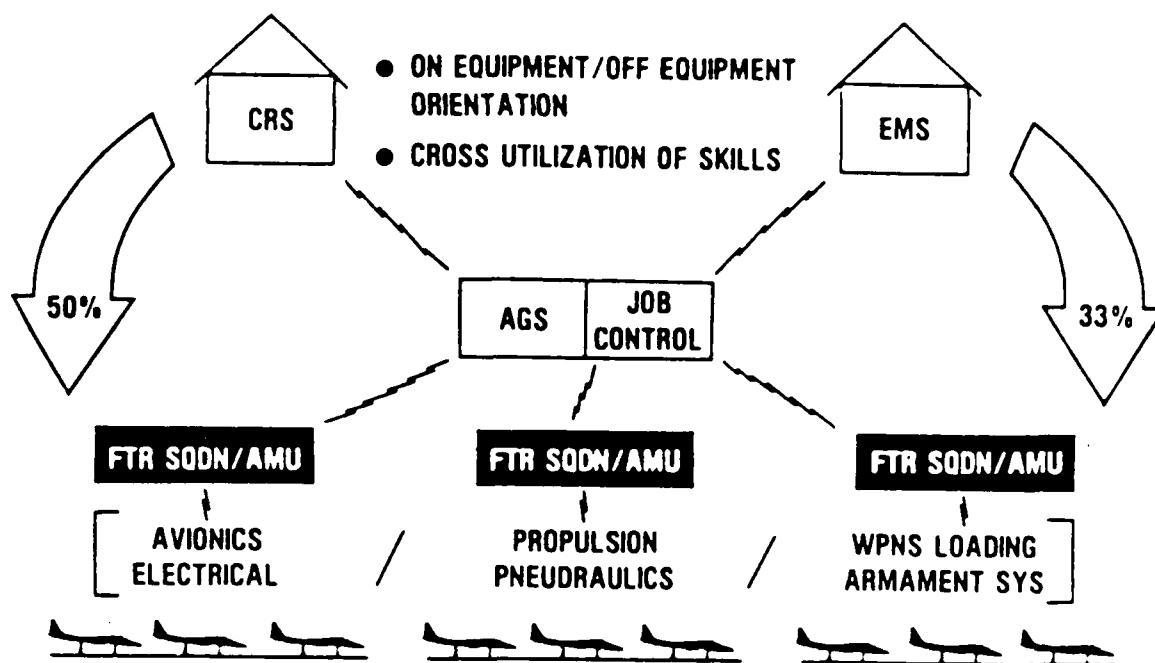


Figure 5 - Production Oriented Maintenance Organization  
Source: TAC Senior Leaders Maintenance Course

and inspection of aircraft were the responsibility of two supporting squadrons, the Component Repair Squadron and the Equipment Maintenance Squadron. These squadrons also had the resources they needed. Job Control established the overall schedule and identified priorities, but for the most part, shops were responsible for their own work scheduling for the majority of their workload.

### Development of the CILS.

The PACAF logistics staff saw an opportunity to modify POMO's off equipment maintenance concept to solve

theater problems revolving around the Korean commitment. The first problem was that nearly 1/2 the PACAF logistics work force was stationed in Korea on a 12 month tour. Since short tours were shared uniformly throughout the Air Force, a large percentage of maintenance personnel were previously assigned to the Strategic Air Command, the Military Airlift Command or the Air Training Command, and had never worked on the aircraft to which they were assigned. Problems caused by a lack of experienced mechanics was exacerbated by an equally serious shortage of experienced senior managers and shop supervisors. PACAF managers describe a short tour syndrome in which the first four months are consumed in training and learning the job, two months of productivity followed by a mid-tour leave, a month of adjustment, two more months of productivity, and 90 days of fantasizing about the return home. In this environment problems of quality and efficiency were to be expected.

The second problem was insufficient airlift to meet the rapid deployment schedules into Korea. The first units were to arrive within 24 hours of their execution order. In-theater available airlift was normally insufficient to meet the rapid deployment schedule and pressure was on for each unit to reduce its airlift requirements.

Finally, there was a consensus among the staff that forward bases were vulnerable. There was pessimism about

the ability of joint U.S.-Korean forces to stop the North Koreans short of Seoul, and bases as far south as Osan AB were considered at risk. Further, commando ranger and sabotage threats extended throughout the peninsula.

The Centralized Intermediate Logistics System (CILS) was established to address these concerns. The CILS consisted of a rear repair center, now called the PACAF Logistics Support Center or PLSC, located at Kadena Air Base, Okinawa; a dedicated air channel system to move parts from the PLSC to forward units; and a logistics control center to monitor priorities and make asset allocation decisions. By establishing the PLSC at Kadena, married maintenance technicians would serve a full three year tour, and unaccompanied technicians would serve 18 months. This provided a more stable work force, with greater training opportunities and more experienced supervision. Deploying units were able to reduce the amount of test equipment they needed to mobilize for deployment, though savings in this area were not as great as anticipated. Most significant, Kadena was a safe haven from the North Korean threat. Units could thus deploy and operate without interruption of deliveries of critical engines and avionics components (46:1).

PACAF established four objectives for the CILS: (1) Improve quality and reduce repair times. By reducing repair times and increasing the in-service life of the repaired

parts, PACAF hoped to increase the total number of serviceable assets available to its units. (2) Reduce logistics costs through realizing economies of scale. Most of the major intermediate test equipment was inherently capable of repairing more items than were generated by a single squadron or wing. Thus, by combining the workload of several small shops into one larger unit, individual peaks in demand could be evened out, and manpower and test equipment could be reduced with no detriment to support. (3) Remove hi-value intermediate maintenance equipment from the high-threat Korean theater to increase survivability. Combat units could depend on an uninterrupted flow of serviceable assets from the repair center safe in the rear, rather than facing the risk of losing their intermediate maintenance support to battle damage. (4) Eliminate the requirement to move hi-value test equipment and associated manpower in order to reduce the airlift required (46:2).

The primary goal for the CILS was to improve logistics support to the unit. For aircraft engines, the objective was to have full war readiness levels (WRM), plus 40% of the authorized peacetime quantity, on-hand serviceable at each operating location, plus have one engine enroute for each scheduled engine change. For other aircraft parts, the objective was to have full WRM plus one asset on the shelf and one enroute to each user (46:3). Given the prevailing

logistics posture at the time, these goals represented a significant improvement.

It is important to note that all intermediate maintenance capability was not removed from the wings. Units equipped with weapons systems with conventional avionics, like the F-4, A-10, and OV-10 have maintained a considerable alignment, test and repair capability. The F-4 communication, navigation, and radar systems, for example, frequently require electrical alignment in order to provide peak performance. Since the equipment required to align the system is frequently the same equipment required to test and repair the system, some duplication of capability exists between the wings and the PLSC. Because of this, PACAF specifies the unit's repair authority in PACAFR 400-50 Vol. III (41). Therefore, although units do not normally go beyond failure verification and alignment, they do have the capability to repair critical components in combat if their supply from the PLSC is interrupted. In addition, repair of TACAN, forward looking radar, and electronic countermeasures was never moved to the PLSC (44:20-26).

Units with integrated avionics are not so fortunate. The F-15, F-16 and A-10 have large test stations which are currently located at the PLSC. These units have virtually no capability to repair avionics LRUs except for test and fault verification by using an aircraft as a testbed.

All units have basic hydraulic, electric and machine shop capabilities as well as a nearly complete engine maintenance capability. All units except the A10 have engine test cell capability at their home base, and at least a tie-down capability at their employment base. Therefore units are capable of doing everything except a complete engine tear down at their forward bases.

Under the CILS concept, therefore, forward units can concentrate on on-equipment repair and sortie generation as long as the system works as programmed. Should the PLSC resupply be interrupted for any reason, however, units will still have a some residual capability to repair parts using the equipment they do have.

#### PACAF Logistics Support Center.

The PACAF Logistics Support Center has grown into a modern production complex occupying 178,013 square foot in ten facilities worth \$37 million. It employs 713 maintenance personnel and 154 supply personnel (50:atch 2), who produce an average of 54 aircraft engines and 1400 aircraft avionics and accessory components per month (49:118-120).

Engine Maintenance. The PLSC has one of the most modern engine maintenance facilities in the Air Force. A new 44,000 sq. ft. addition to the engine shop was constructed with in-floor elevators, which provided the capability to repair the new General Electric F110-100 engine in



the vertical position. The PLSC has the capability to produce a peacetime monthly average of 18 F-100 engines for the F-15 and F-16 aircraft, 16 J79 engines for the F-4, 3 J-85 engines for the F-5, 5 T-76 engines for the OV-10, and 3 TF-34 engines for the A-10 (49:118-120).

Integrated Avionics. The PLSC integrated avionics branch is equipped with two independent and one dependent F-15 avionics intermediate test stations (AIS). This consists of nine automatic stations (computer, microwave, and display test sets) and six manual stations (antenna A and B; communications, navigation, instruments; indicator and controls). In addition it has two F-16C/D AIS each having positions for testing the computer and inertial navigation unit, radio frequency, displays and indicators, and processors and pneumatic stations.

The PLSC enjoys an integrated avionics repair capability that is only matched by AFLC's technology repair centers. Because of the consolidation of integrated avionics repair, the PLSC had the facilities and technical capability to expand beyond strict intermediate repair. After several years of giving the PLSC piecemeal authority to perform depot-level repairs on specific items, AFLC agreed to establish a depot-level circuit card repair capability co-located with the PLSC. The PLSC now receives reparable avionics Line Replaceable Units (LRUs) and performs normal

intermediate level repair. If the repair is beyond intermediate capability, instead of reassembling it and shipping it to the CONUS logistics center, the PLSC transports the LRU in its disassembled condition to the AFLC Support Center Pacific circuit card repair facility in the next building. This means that parts are returned to service within hours instead of the normal 16 day order and ship time required to receive a replacement from the United States.

Conventional Avionics. The PLSC maintains full intermediate repair capability for the F-4 APQ-120 fire control radar, central air data computers, attitude reference bombing computer systems, aircraft instruments and conventional inertial navigation units and navigational aids. Because of the variety of available test equipment, and the ability to use the Support Center Pacific, repair capability is somewhat higher than in a normal wing level conventional avionics maintenance activity (42:69).

Electronic Countermeasures. The PLSC electronic countermeasures shop is almost exclusively devoted to repair of the F-15 tactical electronic warfare system (TEWS), and radar warning receivers. Due to the availability of suitable ranges, the Kadena based F-15s have more system-on time than any other F-15 unit. Because of its extensive repair experience, the PLSC has been instrumental in justifying increased WRM levels for electronic countermeasures spares,

and in identifying and correcting test voids in test station software.

Aerospace Systems. The aerospace systems branch repairs hydraulic, electrical and environmental parts. Because of the specialized test equipment and experienced personnel available at the PLSC, it was granted full depot level repairs authority on many hydraulic actuators and valves.

Asset Management. The PLSC has a full base level supply activity under its director of distribution. The supply activity performs all the normal base supply functions of storage, order, inventory control, and transportation, but the important function for this study is the activity of the readiness center. The readiness center is responsible for monitoring each wings asset posture, and making the allocation decisions for PLSC managed items. It does this primarily through the program C05, Asset Visibility Report. Through special PACAF supply programs, each day, during end-of-day processing, base supply computers generate a C17 card on each item coded as PLSC managed. The C17 card contains the authorized stock level, the number of serviceable and unserviceable assets on hand, any outstanding requisitions, and any outstanding due-outs to aircraft for that unit. The C17 cards are automatically transmitted by each base to the PLSC.

The cards are then batch processed into the PLSC supply computer, which sorts the cards by stock number, matching them with any requisition that was recently shipped. After going through several program controlled sort and match sequences, the C05 report is processed and ready for use prior to 0730 each duty day (42;112). The C05 provides the readiness center the total command asset posture, by base, as of close of business the night prior. The readiness center then uses the C05 report to ship repaired assets to the unit with greatest need. Although both PACAF and USAFE have funded programs to provide real time computer interface between their supply accounts, neither will see this capability for at least two years. The C05 therefore, remains the closest thing to real time theater asset management in the retail supply system.

The readiness center also maintains a MICAP management section to track the status of parts needed for aircraft which are not mission capable. The PLSC receives notification of a MICAP requirement by telephone from the base MICAP control section. The readiness section checks the C05 to determine the quickest method of filling this requirement. For example, if a reparable item is available at the PLSC, and no other item is available in theater that could arrive quicker, the readiness center will contact the shop and direct that the item be given priority. If, on the

other hand, an asset is in repair at the PLSC, but an asset is available at another base and could arrive quicker, the readiness center will direct that base to ship the part. The readiness center will then annotate the transaction and attempt to ship each unit an asset for stock as soon as they are available for repair (42:77).

The PLSC asset distribution system is more responsive than the normal depot level allocation system, because it ships to the unit with the greatest need instead of the unit with the oldest requisition. For example, If all units were out of stock, but had no grounded aircraft, and a part was available from repair, the readiness center would review the projected activity for each wing to determine if one wing should be given priority because of an upcoming deployment, or an operational readiness inspection. If so, that wing would get the part. If all things were equal, however, the unit with the most aircraft would get the part because their average demand would be higher and the chance of their needing the part greater (42:77).

Wartime Asset Control. PACAF expects to use the flexibility offered by this control system in wartime, and practices it regularly. In the event of a conflict, PACAF establishes a Resource Management Center (RMC) under direction of the Air Component Commander. It is the RMC's responsibility to monitor the logistical health of each of the

units and to resolve mission limiting shortfalls as quickly as possible. The PLSC sends qualified personnel to man the Centralized Logistics System (CLS) position on the RMC staff. This person is the interface between the RMC and the PLSC readiness center. The CLS liaison has the authority to direct reallocation of PLSC managed assets to support the priority set by the Air Component Commander (42:107). The PLSC is, therefore, more than just a rear repair facility. Without its presence, there is no other permanent capability to provide the asset visibility and redistribution to meet priority requirements. Couple this with the repair enhancements offered to the theater by the PLSC-SCP interface, and the total package provides a capability which should not be discarded lightly.

#### Support Center Pacific.

Air Force Logistics Command's Support Center Pacific adds considerable logistics sustainability to the pacific theater. In the early 80's AFLC began to look for ways to reduce the costs and improve support to overseas theaters by performing depot maintenance in the theater. The growing capability of the PLSC offered an opportunity to expand in-theater depot repair at a low cost. AFLC's goal was to gradually establish a repair capability for items with high failure rates, where the payoff in increased theater war-fighting potential would be the greatest. The SCP was ini-

tially formed by transferring ten personnel, a supervisor, a secretary, one supply clerk and 7 circuit card repair technicians to Kadena Air Base. The SCP was located in the Support Center Pacific in one of the PLSC repair facilities. The payoff was virtually instantaneous as long standing shortages of F15 radar fire control components began to be resolved.

The SCP is still relatively small, but its popularity among the PACAF maintenance community is immense. The SCP now has the capability to repair electric wire bundles for the most sophisticated test equipment, it also has the only plasmadyne heat coating spray capability outside of AFLC's logistics centers. One reason for its popularity is its willingness to take on virtually any repair job to get an aircraft back in commission. In one case, F-16 units were having continual problems with chaffing on the electrical harness running to the radar. There were none in the system and several aircraft were grounded. The PLSC not only repaired the affected cable, but redesigned it to withstand the rapid flex generated by antenna movement, and eliminated the chaffing problem. This redesign was adopted air force wide at a cost of a few hundred dollars as opposed to a contractor re-design already in progress that was to cost several thousand dollars.

In 1987 alone, the SCP's structural engineer examined and designed repairs for over 60 aircraft. With the addition of a combat logistics support team (CLSS) that was assigned to the SCP in late 1987, the SCP has full capability to repair aircraft structural deficiencies. The SCP also repaired 1642 F-15 and F-16 avionics LRUs with a value of over \$25 million (1:4). The SCP has truly enhanced the theater logistics supportability, and provisions should be made to retain it in any future theater logistics structure.



## CHAPTER IV

### THE MILITARY THREAT

The viability of the Centralized Intermediate Logistics Concept depends on the survivability of the central repair facility. All of the economies of scale and purported efficiencies of a large central facility mean nothing if that facility does not survive. PACAF's selection of Kadena AB as the site for the PLSC was primarily based on the premise that Kadena was a safe haven.

Prior to the 1980s, the U.S. viewed North Korea as the primary threat to peace in the region. Since North Korea had no long range bombers, and North Korean attacks on Japanese soil were very unlikely, the view that Kadena was a "safe haven" was not widely disputed. The preponderance of Soviet force in East Asia was defensive, with a limited power projection capability. It consisted of ground forces arrayed against China, short range fighter aircraft, and a defensively oriented Pacific fleet.

#### Soviet Forces.

The Soviet military build-up in the 1980s has changed the threat. Since 1980, the Soviets have increasingly developed their power projection capability. They replaced their older tactical fighters with newer generation MIG-27 floggers, SU-17 fitters, and SU-24 fencers.

They deployed bombers in increasing numbers, and now have 70 backfire, 52 bear and 170 TU-16 bombers in the Far East Military District. Backfires regularly transit from their home bases in Kamchatka and Manchuria to Cam Rahn Bay, Vietnam, demonstrating their capability to threaten all U.S. bases in the Western Pacific (68:84). At the same time, the Soviet fleet has become the largest and most modern in the Soviet Navy. The fleet now has over 400 ships, (84 principal combatants) and 120 submarines. In addition, two of the four Soviet aircraft carriers operate in the Pacific (73:9).

The Soviet base at Cam Rahn Bay adds another dimension to the threat. Since 1979 they have continued to build up port and airfield capabilities. Currently 25 to 30 ships and several submarines regularly operate out of Cam Rahn Bay, and 25 bombers and two regiments of MIG-23 fighters are maintained at Da Nang (68:85).

#### Soviet Strategy.

Although the majority of the Soviet surface and submarine fleet will undoubtedly be devoted to protecting the operating areas in the Sea of Okhotsk and the Sea of Japan, it would be contrary to Soviet doctrine for them to assume a totally defensive posture. They will seek to

neutralize U.S. forces in the Asian Pacific by any means: politically, if possible, militarily, if not.

Soviet doctrine stresses surprise and bold offense as critical to victory. They believe that success will be achieved by the side which "acts more aggressively and resolutely, takes the initiative and holds it firmly."

(18:116) The side which only defends is inevitably doomed to defeat. Surprise gives the attacker the all-important initiative, and disrupts the careful plans of the defense. It increases the defenders confusion, and leaves him less capable of adjusting to new and unwelcome circumstances.

Recent Soviet military writers have stressed the need to strike in depth during the initial hours of a future war. With the Soviet emphasis on pre-emptive strikes to destroy enemy air (55:98), U.S. air bases will be prime targets. U.S. military leaders normally focus on the formidable Soviet air threat, but there is good reason to believe that attacks on our bases will be multi-dimensional. In his 1985 book, History Teaches Vigilance, former chief of the Soviet General Staff, Ogarkov, postulated that new precision conventional weapons are approaching the rear area strike effectiveness of nuclear weapons (21:71). General-Lieutenant M. Proskurin wrote in a 1984 Red Star article, that conventionally armed cruise missiles, reconnaissance strike complexes (space?) and other long range

precision munitions could be used to attack vital communications, airfields, and logistics depots (21:72).

Admiral Crowe has characterized the Soviet's Vietnam build-up as "changing the strategic and military calculus in the region." (28:67) The 1800 mile unrefueled radius of the TU-16 badger (73:36) enables it to attack all of Southeast Asia and targets as far North as Okinawa, Japan, and South as Indonesia (Figure 6). The badger can carry the radar-homing AS-5 kelt and AS-6 kingfish air-to-surface missiles. The kelt can carry a 2200 lb. high-explosive warhead up to 200 miles, and the kingfish can carry either conventional or nuclear warheads even further. Thus groups of 4 or 5 aircraft, attacking in typical "wave" tactics, could approach U.S. installations in Guam, Okinawa and the Philippines by cruising at altitude, dropping to low level, and popping up to release their missiles up to 200 miles from their target without ever being detected by land-based air defense networks (28:69).

The forces in Vietnam provide a formidable anti-submarine warfare (ASW) capability and threaten to close the oil shipping lines through the straits of Malacca and Sunda. The carriers Minsk and Novorossiysk provide a formidable ASW capability, and, when coupled with the recently deployed Ivan Rogov-class amphibious assault ships, provide

FIGURE 6 -- TU-16 COMBAT RADIUS



a moderate capability for small scale amphibious assaults (28:197).

The Soviets also plan to target rear areas with special forces, "*spetialnoe naznachenie*", or SPETsNAZ. Soviet SPETsNAZ teams of 8 to 10 men train to infiltrate and attack nuclear storage areas, mobile missiles, command and control facilities, air bases, port facilities, and lines of communication. SPETsNAZ teams may be inserted prior to hostilities, airdropped, or inserted by submarine. The Soviet Pacific fleet is estimated to have approximately 1300 SPETsNAZ and be capable of deploying 100 teams (6:132).

#### PLSC Vulnerability.

The ability of the Soviets to attack U.S. installations on Okinawa with a combination of TU-16 badgers, intermediate range ballistic missiles, SPETsNAZ, and cruise-missile carrying submarines means that Kadena can no longer be considered a safe haven. Threat is relative, however. The Soviets still have to penetrate 1500 miles of allied defended airspace to reach Okinawa from Cam Rahn Bay and 1100 from Vladivostok. Submarines would face an equal challenge from U.S. and allied ASW forces working out of Subic Bay and ports in Japan. Even if Soviet forces reach Okinawa, it is unlikely that PLSC facilities would be the primary target. Kadena's E-3A AWACS, F-15 fighters, KC-

135 tankers, and dual runways, offer at least as tempting a target set as the PLSC's spread out complex of repair centers (see appendix B).

#### Forward Bases.

Bases on the rim of the theater, in Northern Japan, Korea, and the Philippines face a more concentrated threat. Misawa AB, in Northern Honshu, is within range of several regiments of ground attack fighters as well as the preponderance of bombers in the Soviet Far East Military District.

The militant and unpredictable regime of Kim Il Sung in North Korea poses a formidable threat to South Korea, and must be dealt with in any conflict envisioned with the Soviet Union. North Korea's standing army of 750,000 men, its 60,000 man commando ranger force, and new acquisitions of MIG-23 fighters and attack submarines put all U.S. bases in Korea in danger of attack.

The threat to U.S. installations in the Philippines will come predominantly from Soviet forces at Cam Rahn Bay, but the Vietnamese forces cannot be discounted. The Vietnamese Air Force is still the most powerful in Southeast Asia. The backbone of their air defense force is 180 updated MIG-21 fishbeds. Although lacking any significant long-range projection capability, they do pose a threat to ASEAN neighbors. The Vietnamese also operate a net of over

100 radar sites linked to form a sophisticated net of detection and ground controlled intercept capability. This net would seriously challenge any U.S. attempt to strike Soviet targets at Cam Rahn Bay and Da Nang. In addition, Cam Rahn Bay is reported to be protected by SA-2 and SA-3 surface to air missiles (28:71).

Combat Environment.

The large over-water barriers between U.S. and Soviet forces in the western Pacific dictate that war will be fought primarily with air and naval forces. Distance also dictates that the tempo of conflict is not likely to be particularly intense. The great distances, and powerful land-based air defenses lead to long-duration sorties and the need for both sides to mass airpower for offensive attacks against the other. Force coordination for large force packages is a critical, time-consuming function. To prepare a large number of aircraft ready to go at the same time is also a demanding maintenance task. Some aircraft are brought up early, and they sit while the remaining aircraft are generated. As we learned in Vietnam, you do not fly high sortie rates while generating large amounts of aircraft and flying long-duration sorties.

Korea is another matter. The North Koreans have massive forces poised against the South. Korean conflict will involve massive, intense ground combat that will re-



quire the full spectrum of air support. Because the South Korean capital of Seoul is only 40km from the boarder, the joint U.S.-ROK Combined Forces Command have deployed their forces forward, and have declared that any invasion must be stopped North of Seoul. The employment of massive amount of U.S. and ROK airpower is crucial to the success of the forward defense strategy. Consequently the U.S. must be prepared for maximum numbers of sorties during early days of the conflict (52:A8-A11).

This does not mean that fighting against the Soviets will not be ferocious and the attacks intense, on the contrary, they will be. The potential for losing critical combat resources is great, and PACAF needs passive defense measures such as aircraft shelters and hardened maintenance and supply facilities just like Europe. The point is, however, that, when determining aircraft parts requirements, the Korean battle is still the most demanding.

#### Risk Assessment.

The proximity of the Soviets and their allies, the North Koreans and Vietnamese to U.S. air bases in northern Japan, Korea and the Philippines place them at far higher risk than Kadena. The question remains, however, is the risk greater with one centralized repair facility at Kadena, facing only a moderate threat, or with a dispersed

set of facilities located at forward bases where each, individually, face a greater threat?

There is no absolute answer, but the conclusions of Project RELOOK would support dispersing repair to the units. The risk of losing all avionics repair capability for all the F-15s and F-16s in the theater, in a single strike, is too high, even if the potential for such an event is low. If, on-the-other-hand, repair is dispersed, and capability at one base is destroyed, it is still possible to get support from another unit.

The fact remains, however, that repair facilities in the forward area are more vulnerable. To decrease the vulnerability, critical, high-value test equipment must be located in hardened and protected facilities. Personnel must be trained to protect themselves and their equipment, and to react to minimize damage and to resume sortie generation activities after attack (39:5).

Even with these measures, some critical capabilities are sure to be destroyed. Without logistics communication capability and the ability to airlift critical aircraft spare parts to the base, combat capability will fall quickly. PACAF justified the Pacific Distribution System (PDS) based on the need for an assured means of communicating parts requirements to the PLSC, and for moving aircraft spares to and from the PLSC. With the projected phase-out

of the PLSC, there is a danger that the PDS will be lost also. It is my contention that PDS is an essential system which will reduce the risk and ensure viable logistics support under either option, centralized or decentralized. It must be retained to assure wartime support to forward units.

## CHAPTER V

### PACIFIC DISTRIBUTION SYSTEM

The Pacific Distribution System was designed to improve the responsiveness of the CILS in peacetime, and to assure the capability to provide uninterrupted support to combat units in wartime. It consists of three parts: (1) a fleet of small aircraft dedicated to the movement of aircraft parts; (2) a logistics command, control, and communications system; and (3) an Air Force Logistics Command theater forward stockage point for combat required spare parts (52:1).

### PACIFIC DISTRIBUTION SYSTEM

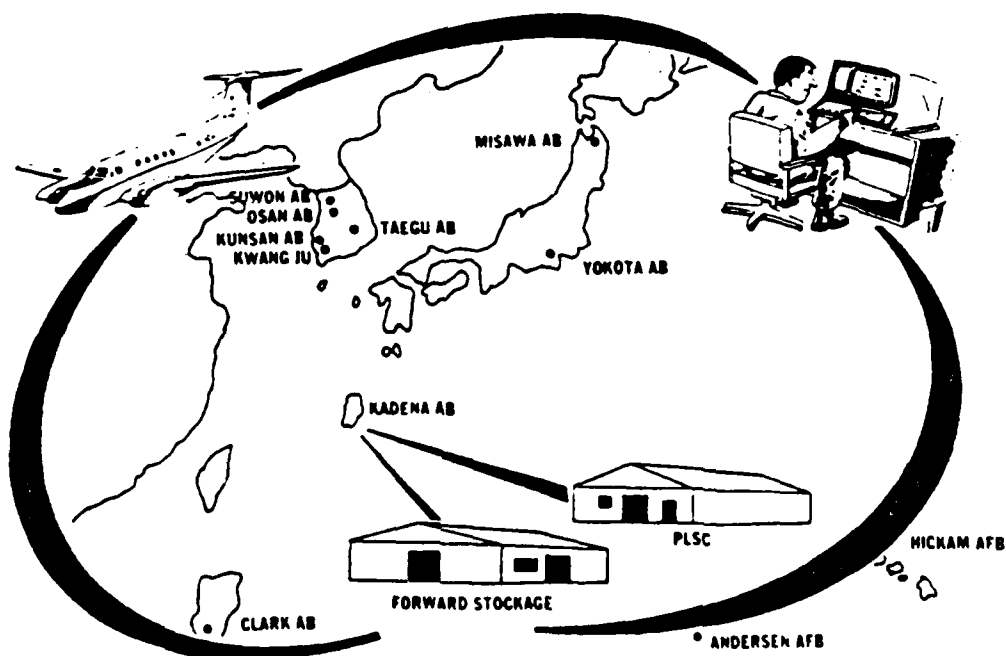


Figure 7 -- Elements of the Pacific Distribution System

The real need for PDS lies in its flexibility for dealing with logistics disasters which otherwise could dramatically reduce the sortie production of the whole theater. The PDS, like its counterpart, the European Distribution System (EDS), provides the theater component commander with the ability to move parts, people, and equipment within the theater to resolve logistics problems and to maximize theater combat capability.

#### Description of PDS.

PACAF wanted a fleet of small aircraft that could augment the regular MAC channel airlift to provide twice a day delivery of aircraft parts from the PLSC to forward units in peacetime, and to assure a dedicated means of transportation that would not be removed in wartime. They looked at the Sherpa which was purchased for EDS, but it did not have the necessary range or speed to be effective on the long over-water delivery legs to and from the PLSC.

Although PACAF would have liked an aircraft which could carry an aircraft engine, the only commercially available aircraft that could meet the range and speed requirements rivaled the C130 cargo capability. They were simply too large and too expensive to buy and operate. PACAF saw the C-12 aircraft operating in MAC's operational support aircraft (OSA) fleet as a ready alternative. PACAF had already been authorized eight of these aircraft for adminis-

trative support, and a logistics supply and maintenance system was already in place.

PACAF determined that, by cannibalizing engines from aircraft grounded for other parts, units could operate for three weeks before engines became the limiting factor. By all calculations, airlift would be available to move engines from the PLSC to units prior to that time (45:17). Therefore, cargo requirements could be based solely on the amount of aircraft parts moving to and from the PLSC.

They found that 90% of the PLSC cargo was less than 45 cu.ft. and weighed less than 75 lbs. Total cargo was forecast to be less than 1000 lbs. for each programmed leg. The C-12's 1200 lb. cargo capacity and 4' x 4' cargo door met both requirements (45:17). PACAF received six C-12s and began PDS operations in November 1987.

While assured transportation is the critical component which ensures the viability of the PLSC concept in combat, the dedicated communications link proposed by the PDS statement of need (SON) makes the system efficient. The logistics command, control and communications system for PDS links the supply computers of all PACAF bases. It will provide the capability for any PACAF base to query the system and find a part anywhere in the theater. More important, however, it provides real time asset visibility to the PLSC readiness center and Resource Management Centers (RMCs)

at HQ PACAF; Osan AB, Korea; Yokota AB, Japan; and Clark AB, Philippines which would be activated in the event of a conflict.

The PDS log C3 system will interface with MAC's ADAM system in order to track parts in the transportation system and to schedule parts for the next available aircraft. A PDS transportation control function is co-located with the MAC transportation control center at Kadena to plan and coordinate this movement.

The PDS system will work like this. Misawa AB orders an aircraft grounding, MICAP, part from the PLSC. The PLSC MICAP control center queries the PDS computer and determines that the quickest source of supply is a part at Kunsan. The MICAP section enters the direction in the computer, and a shipping document is cut for the property. Kunsan base supply moves the property to the MAC shipment control center, where the joint transportation control center searches to determine the quickest delivery mode. It passes up a C130 that is going to Yokota, and places it on the PDS aircraft that arrives in Misawa that evening. The requirement was satisfied in less than 12 hours.

Without PDS, the same transaction takes 3 to 5 days. In a typical example, a MICAP requirement is generated at MISAWA on the morning of day 1. It is passed to supply MICAP section, which verifies the requirement and puts it

into the computer. Supply then attempts to reach the PLSC MICAP section by autovon, which is nearly impossible during the day. The requirement is finally passed to the PLSC MICAP section at 2100. The PLSC monitor checks the COS asset visibility report, which by this time is nearly 24 hours old, and sees that three items are in repair. By this time the shop is closed, so the requirement sets over night. Day 2. The next morning, the shop reports that the assets will be ready by 1200. The parts are moved to the MAC terminal that afternoon and are scheduled to move on a C141 the following day. Day 3. The part leaves on the C141 at 1100 and transits the regular channel route from Kadena to Taegu, to Kunsan, to Osan and then remains over night in Yokota. The cargo is off loaded and moved to the end of the cargo waiting shipment to Misawa. Day 4. The Misawa aircraft is full before this part is loaded. Day 5. The part moves to Misawa and arrives at 1200.

While this scenario may seem contrived to depict the situation in the worst light, it is not. The average movement from the PLSC through the MAC terminal to the first stop is 48 to 56 hours, and cargo frequently takes another 48 to 56 hours to transit Yokota.\*

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\*Data was provided in a briefing by a HQ PACAF/LGT team investigating complaints registered by the commander of the 432TFW, January 1987.



PACAF received six C-12 aircraft and began PDS air-lift operations in November 1987. The PDS system is flexible and able to respond to unprogrammed high priority requirements, but normal PDS routes have been programmed as depicted in Figure 8.

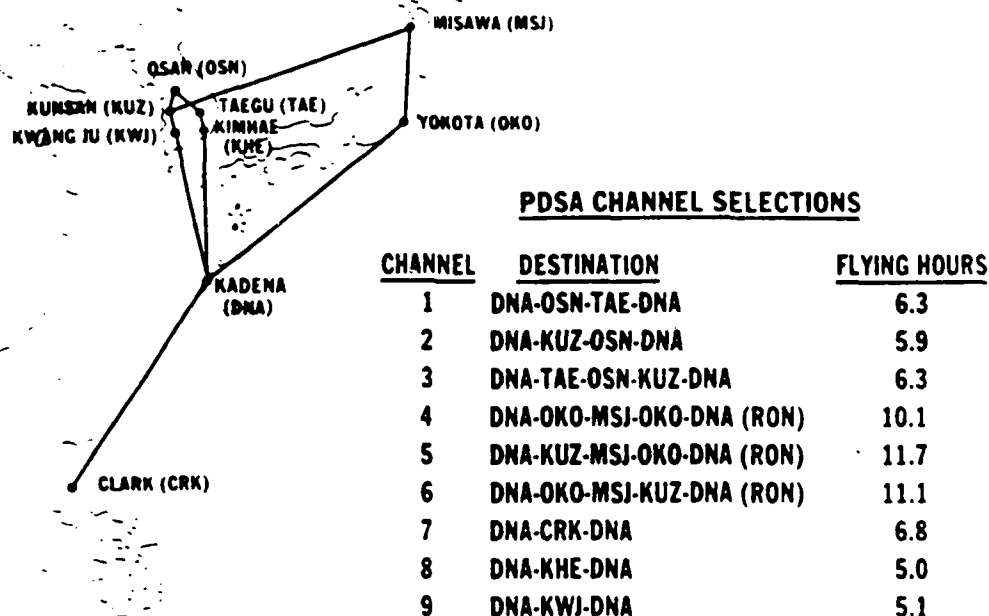


Figure 8 -- PDS routes and flying time.

#### PDS Payoff.

The principal PDS payoff lies in its ability to rectify logistics breakdowns before they stifle a wing's ability to produce enough mission-capable aircraft to meet its wartime mission. Breakdowns in logistics support occur from four major causes: (1) The extreme variability of

demand for some items which makes it virtually impossible to adequately forecast requirements; (2) interruption in resupply due to nonavailability of airlift or airfield damage; (3) damage to supply warehouses or critical repair facilities; and (4) nonavailability of parts due to a failure in the CONUS depot resupply system. PDS provides the capability to minimize the impact in each case.

Variable Demand for Parts. Variability of demand creates support problems even in peacetime. Stock levels for the relatively low cost economic order quantity (EOQ) parts are based on a summation of the operating level and a quantity calculated to cover requirements generated during the order and shipping time. The operating level is calculated to be the most economical amount of stock that will support the day-to-day mission. It is based on the formula:

$$\text{operating level} = 8.3 \times (\text{daily demand rate} \times 365 \times \text{unit price}) / \text{unit price}$$

The reorder point is based on the order and shipping time quantity plus a safety level. The order and shipping time quantity is the amount of stock necessary to support the average demands during the average order and shipping time, computed using the formula:

$$\text{O\&STQ} = \text{daily demand rate} \times \text{average order and shipping time.}$$

The safety level is a calculation of the standard deviation of demand during the order and shipping time period. The current standard base supply system calculations use a variance to mean ratio of three. This is inadequate. An Air Force Logistics Management Center study of variance to mean ratios for EOQ items at five bases showed that:

"The current system provides an accurate estimate for fewer than 57% of the Air Force consumable items. THE CURRENT SYSTEM DOES NOT ACCURATELY MEASURE DEMAND VARIABILITY WHICH RESULTS IN INEFFECTIVE STOCKAGE FOR OVER 40% OF AF CONSUMABLE ITEMS." (5:12).

Variance to mean ratios (VTMR) for high-cost, repairable, aircraft components is not much better. Colonel Tripp, program director for the Requirements Data Bank, Logistics Management Systems Center, reports that the F-15 computer programmer had a VTMR of 9 over a three year period. A VTMR of 9 means there is a high variability. Therefore, it is difficult to predict future demands accurately (70:23). Figure 9 shows the VTMR distribution for items in the F-15 War Readiness Spares Kit (WRSK). Fifty percent of the items have a VTMR greater than 1.5. Since WRSK levels are developed using a VTMR of one, stock outages are expected.

The Dyna-METRIC computer model calculation of the impact of various VTMRs on available combat aircraft is depicted in figure 10. To illustrate, let's examine two items with the same average demands during the O&ST (figure

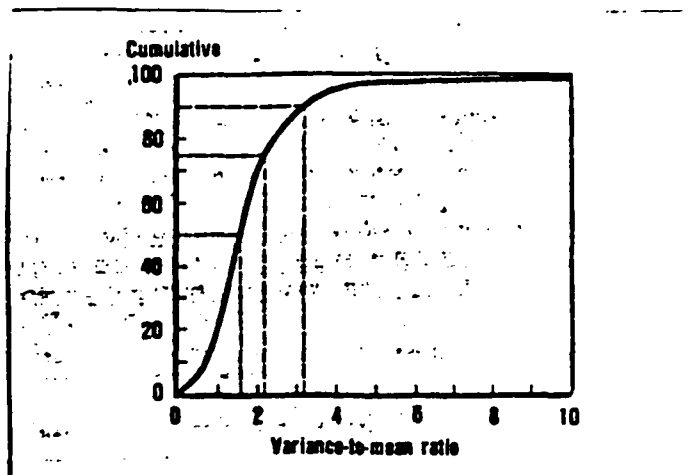


Figure 9 -- Distribution of VTMRs for parts in the F-15 war readiness spares kit (WRSK) (70:24).

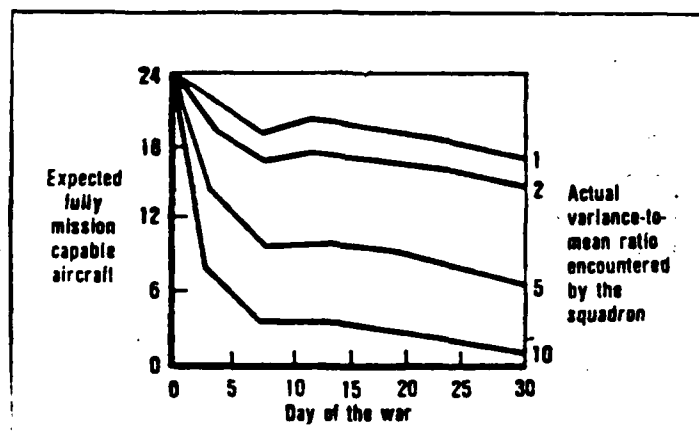


Figure 10 -- Impact of VTMR on wartime aircraft availability (70:24).

11). Item A's demands range from a low of 2 to a high of 38. The average demand is 20. Item B's demands range from 10 to 30 and also have an average of 20. Since the reorder point is based on the average O&STQ, reorder points for both items are the same, in this case 28 (O&STQ + SLQ). Figure 12 shows that a reorder point of 28 for item A will only be sufficient to cover demands during the order and shipping

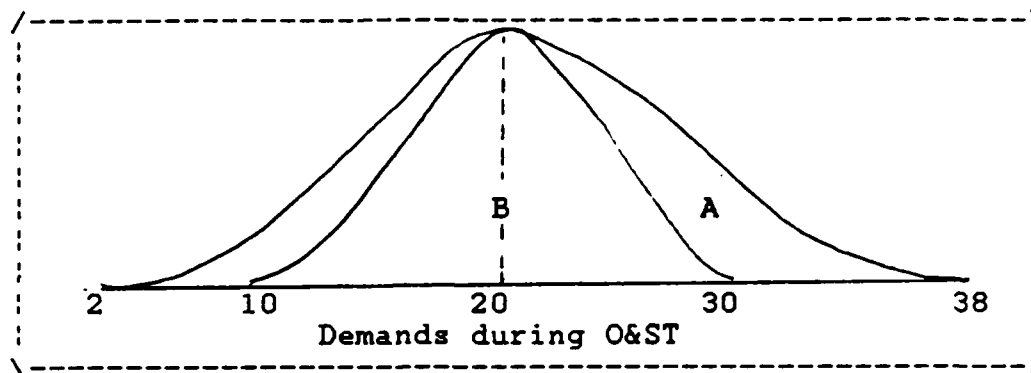


Figure 11 -- Sample demand distribution.

time period 60% of the time, meaning that 40% of the time stock will run out and aircraft may be grounded.

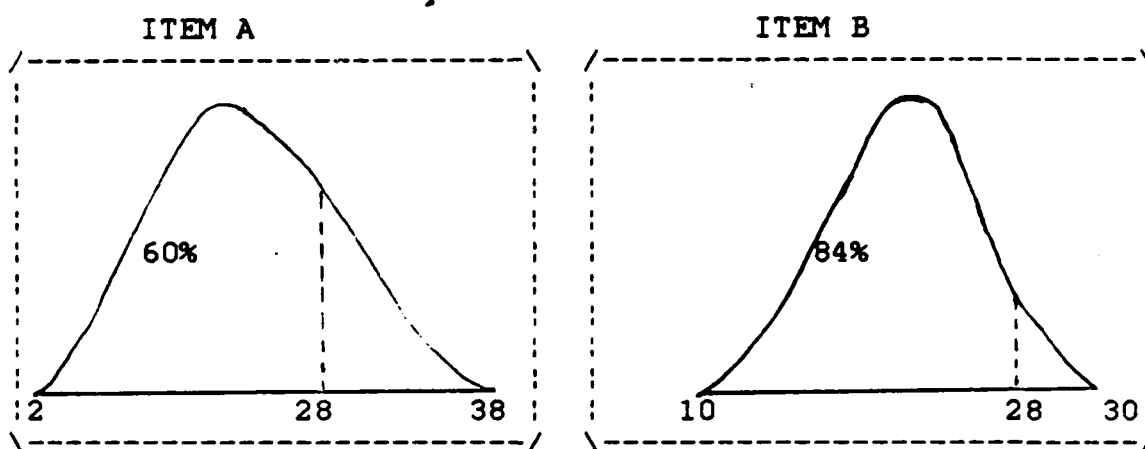


Figure 12: Impact of variability of demand on stock outage.

On the other hand, the reorder point of 28 for item B provides an 84% probability that stock will be sufficient to cover the O&ST period. Buying additional spares to ensure that the WRSK will fully support combat units is prohibitively expensive. Figure 13 shows that it will more than

double the cost of an F-15 WRSK to raise the quantity of each item up to the level that will provide an 84% probability of meeting the requirement (5:12).

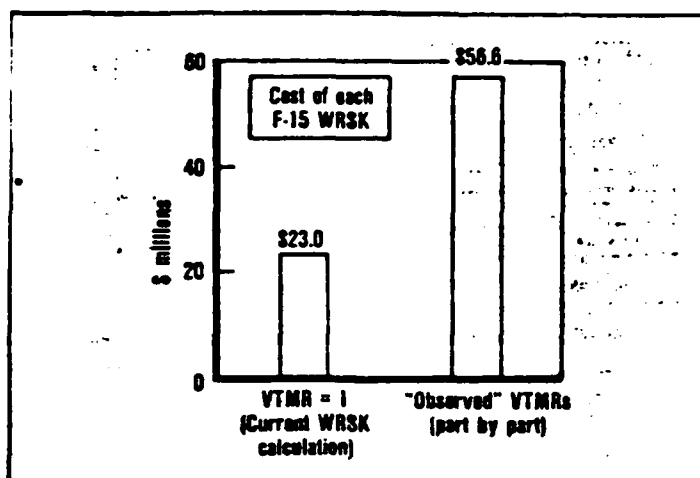


Figure 13 -- Cost comparison of current F-15 WRSK to one fully funded to cover high VTMR parts (70:24).

PDS provides an economical method of improving total theater support without increasing inventory costs. This is possible because, if the order arrives within the average O&ST, 60% of the time there will still be some stock on hand for item A, and 84% of the time for item B. Using Table 1 for illustration, PDS can prevent or satisfy requirements for aircraft grounding conditions by moving part A from base 2 to base 1, and by moving part B from either base 1 or 3 to base 4.

The EDS is doing this in USAFE today. In fact, 40% of the parts required to return aircraft to mission capable status are provided by lateral support from another USAFE base (69:iii). A Rand study estimated that the responsive

TABLE 1 - STOCK ON HAND

	Base 1	Base 2	Base 3	Base 4
Item A	0	10	1	4
Item B	10	1	10	0

redistribution of spares by EDS would result in an additional 300 to 800 combat sorties per day (59:10-30). No similar study has been conducted for PACAF. Currently approximately 10% of the MICAP requirements are satisfied by lateral support from another PACAF base. As repair is decentralized to the units, and as additional wings convert to F-16 aircraft, the percentage of requirements satisfied by lateral support is likely to raise to the levels reported by USAFE.

Destruction of Supplies. The PACAF Operations Analysis Office did a study on the impact of the loss of all stock of 30 parts in the F-16 WRSK. No resupply was assumed for 10 days. Using a dyna-METRIC-like model and taking break rates and repair rates from the DO29, they calculated that nearly half of the wing's aircraft would be out-of-commission in spite of cannibalizing every available part from grounded aircraft (52:B8). PDS will provide the necessary logistics communication, asset visibility and transportation to redistribute parts within the theater to maximize total combat sortie capability.

Destruction of Avionics Repair. In the absence of resupply, the destruction of avionics repair capability would be disastrous. To illustrate, a typical problem part for the F-15 radar system fails an average of 14.3 times per 1000 flying hours (52:B11). The authorized level in the WRSK is 17, but 6 or 7 are normally in the pipeline as a result of peacetime flying. Flying at the wartime rate, a 72 aircraft wing will break more than 4 of these parts per day. Depot resupply time is assumed to be 15 days. If repair is lost on day 1, the unit will be out of parts by day 4, will have 18 broken aircraft by day 8, 24 by day 10, and 41 by day 18, when, hopefully, a resupply pipeline is established, or repair restored. With PDS it is possible to set up a repair and resupply shuttle between the affected base and one with the necessary repair capability. Once PLSC assets are returned to the units, there will be no system that won't have at least one backup source of repair.

Airlift Shortfall. There are many circumstances where the total theater airlift falls drastically short of what is needed. During the early days of a conflict, virtually all airlift is committed to deployment of forces, and established theater airlift channels are at risk.

During contingencies and emergencies CINCPAC has operational control of theater C130 aircraft, and MAC retains control of the C-141 and C-5 strategic airlift.



CINCPAC exercises control of theater airlift through his Air Component Commander, CINCPACAF, who, in turn, directs airlift through the commander of the 374th Tactical Airlift Wing (37:6). Because of the obvious need to move parts from the PLSC to the units engaged in combat, it is possible that CINCPAC will elect to retain the existing dedicated airlift resupply schedule. However he will be faced with the difficult choice of moving a full C130 load of personnel and equipment for a badly needed augmenting squadron, or moving a partial load of two to four thousand pounds of critical aircraft spares. Once the PLSC repair is returned to the wings, it is almost certain that airlift will not be available to provide lateral support between wings, at least not during the deployment phase of the conflict.

The PACAF Operations Analysis Office has modeled the impact of a ten day airlift interruption of PLSC deliveries using a VECTOR analysis. VECTOR computes the estimated pipeline quantity and the probability of backorders for each part for a given day. Combining the probabilities for each item in the WRSK, and assuming the unit will cannibalize already grounded aircraft to repair the remaining, the program computes the expected number of aircraft grounded for parts. The analysis concluded that by day 10, PDS movement of parts to and from the PLSC would result in an additional squadron of mission capable fighter aircraft (52:B17).

Combat Risk. There is no question that airlift aircraft will be prime targets in any future conflict. Soviet SPETsNAZ and North Korean commando rangers have airfields and logistics channels as primary targets. While the small PDS aircraft would be unlikely to draw their fire, a fully loaded C141 or C5 would be a prime target for a shoulder fired SAM (8:35).

Airfield Damage. Airfields under attack also present a problem. Ramp and runway space for most bases in the Pacific are already limited. Many bases cannot handle more than two C141s at one time without affecting fighter flying operations. If they are damaged during an air attack, most bases will be unable to receive C141 and C5 aircraft until the runway and ramp are repaired. The PDS aircraft is much more flexible. It takes little ramp space, and is able to use runways as short as 1500 ft.

Forward Stockage.

The final component of PDS, forward stockage, is a proposal to move a portion of AFLC supplies to the forward theater where they can be quickly moved to units in combat. The exact nature of these supplies has not been defined, but for a similar facility at RAF Kimble, England, a primary criterion is that AFLC has full stock levels in CONUS depots. This approach appears to provide little promise of improving theater combat capability, because, If AFLC depots

are fully stocked, then units normally will also have their full authorizations of these parts. The PACAF Director of Maintenance Engineering has suggested that the focus should be on items that have a low peacetime usage rate, and therefore have low levels of base stocks, but have high wartime consumption rates. Such items as wings, flight control surfaces, sheet metal and other basic structural stock, hydraulic tubing, etc. are likely candidates.

Summary.

PDS is essential to PACAF combat operations as a combat multiplier for its limited fighter force. Units in combat will stress the existing logistics system and aircraft will be grounded for lack of parts. Intra-theater airlift will be taxed to the limit moving supplies, food, equipment and munitions to forward units. It would simply be too inefficient to fly a C130 to pick-up a handful of critical aircraft parts, when it could be, and should be, used to fly full loads of combat supplies and munitions to forward units. A small, efficient aircraft like the C-12 can be used effectively in this roll, and , for a fraction of the cost of a single fighter aircraft, can generate an additional squadron of mission capable aircraft. In the uncertainty of combat, PDS can lower the logistics risk.

## CHAPTER VI

### COST OF DECENTRALIZING THE PLSC

The decision to decentralize PLSC repair capability and return it to PACAF units cannot be taken lightly. Over the past ten years substantial investment has been made in facilities and equipment. Decisions to defer the procurement of tools and test equipment needed for independent wing operations were possible due to the economies of scale offered by the consolidation of maintenance into single repair shops. The Support Center Pacific, and the Pacific Distribution System have been justified based on the presence of the PLSC. In addition, two of the factors which entered into the original decision to form the PLSC, 12 month Korean tours and limited airlift, remain unresolved. The costs and benefits of dissolving the PLSC must be examined and weighed on a case-by-case basis.

#### Facilities.

The cost and availability of facilities is a primary consideration in the decentralization decision, both because of the length of time it takes to design, get budget authority, and build, and because of the austere budget projection for the next five years. Cost projections are as follows:

TABLE 2

Programmed PLSC Projects

<u>Project</u>	<u>Sq Ft</u>	<u>Cost {000}</u>	<u>Protect</u>
Avionics Bldg	40,800	\$6,100	\$12,400
FY88 MCP			{semi-harden}
Command Test Cell	14,488	16,473	N/A
FY87 FIP			
Engine Shop			4,100
			{splinter protection}
Totals	<u>55,288</u>	<u>22,573</u>	<u>16,500</u>

TABLE 3

Facilities Required at Units

<u>Function</u>	<u>Kadena</u>	<u>Clark</u>	<u>Osan</u>	<u>Kunsan</u>	<u>Suwon</u>	<u>Taequ</u>	<u>Misawa</u>
Engine shop							
Sq Ft	0	35,000	7,000	1,000	11,000	20,000	10,000
Cost {000}	0	3,100	890	140	1,205	1,952	1,810
splinter protect	0	500	910	20	195	298	440
Test Cells	0	0	60	0	300	300	0
Avionics							
Sq Ft	0	10,000	5,000	7,000	0	5,000	8,600
Cost {000}	0	1,100	600	880	0	670	1,660
Semi-harden		1,200	500	670	0	480	1,290
Total basic		<u>4,200</u>	<u>1,550</u>	<u>1,020</u>	<u>1,505</u>	<u>2,992</u>	<u>3,470</u>
add for protection		1,700	1,410	690	198	778	1,730

Source: Pacific Air Forces, Director of Maintenance Engineering, internal memo, "Facilities Cost Comparison", February 12, 1987.

Although the \$22,573,000 worth of programmed facilities which can be canceled at the PLSC seems to offset the \$21,510,000 required to build semi-hardened facilities at forward bases, it is not so simple. The \$16.5 million

programmed for the command test cell was funded by the Japanese and only the \$6.2 million required for Misawa is likely to be offset from this cancellation. Money for facilities in Korea must first be requested from Korea and be approved or turned-down before it can be submitted for U.S. military construction program funding. Funding for Philippine programs has been particularly sparse due to the uncertain political situation.

Fortunately there are some alternatives. PACAF owns a set of avionics shelters and an "agile aire" capable of housing F-16 avionics test stations. PACAF could move the shelters to Misawa and the "agile aire" to Kunsan to provide interim facilities. A measure of protection could be provided by placing these facilities in aircraft shelters or revetments.

Other activities can be accommodated by reallocation of existing space. Since Clark has not changed aircraft, shops for their maintenance can return to their former location. There is adequate time to program for any new requirements if and when a new aircraft conversion is programmed. Osan and Taegu are scheduled to lose their F-4s in FY89 as Osan converts to the F-16, therefore it would be best to leave maintenance for their F-4s at the PLSC until they complete their conversion. Finally, the engine shop for Misawa can handle the anticipated workload, al-

though it will be extremely cramped, and spare engines must be stored elsewhere.

#### Manpower.

Manpower costs provided the biggest surprise in this study. One of the anticipated benefits of centralization was anticipated manpower savings. According to the Logistics Composite Model (LCOM) for manpower, decentralization would require 87 fewer spaces for maintenance and 32 fewer for supply (45:2).

#### Personnel.

The major impact on personnel is the increased number of short tours. Decentralization would create 227 more positions in Korea, of which 172 are maintenance, 29 supply, and 26 base support. Assignments for PLSC personnel could be handled by normal rotation.

The increased number of Korean tours also creates more requirements for enroute maintenance training. Because of the already short tour, the Air Force has supported the policy that all required training be conducted prior to an individual reporting for duty in Korea. Historically up to 50% of the assigned personnel have no prior experience on the aircraft, therefore, an additional 73 people will have to be trained enroute to their assignment.

### Aircraft Spares.

Although it is difficult to measure the effect of decentralization precisely, it appears to require fewer spare parts. Because of the additional transportation pipeline time required to ship items to and from the PLSC, theater requirements for line replaceable units (LRUs) are greater when repair is centralized. The PACAF Directorate of Supply estimates that the total theater supply for the average LRU will be reduced by 12% once the PLSC is disbanded (51:1). This reduction is counterbalanced by the requirement for more of the component parts required to repair the LRUs. Each Wing will be authorized an adequate range and depth of stock to ensure a repair capability equal to that of the PLSC. The increases will vary by weapons system, with the least impact on the F-15 and A-10, which still will have only one unit repair center, and the most impact on the F-16, for which three units will have repair centers.

### Avionics.

PACAF realized virtually no savings in avionics test equipment as a result of centralizing repair at the PLSC. Therefore decentralization is relatively easy. For example, the F-15 avionics repair can be turned over to the 18th TFW in place, technicians won't even need to change their lockers. Similarly, F-4 units already have most of



their conventional avionics test equipment. The few additional pieces they need are available at the PLSC. The transfer of F-4 avionics requires only a transfer of personnel and lay-in of component repair parts.

The F-16 AIS transfer is not so easy. The AIS has nearly as many component parts as the aircraft, and they are in short supply. Test station reliability is a problem, and most units keep one station up by using parts from the other station. Although reliability improved toward the end of 1987, for most of the year, the PLSC kept its first set operable only 90% of the time, and its second set 60% (49:115). Unless reliability improves, or additional spares are received, PACAF should retain its F-16 avionics repair at the PLSC until it receives its third AIS, which is now programmed for the first quarter of fiscal year 1989. At that time, two stations could be moved to Kunsan to support both Kunsan and Osan, and the third station could be shipped to Misawa. With PDS making a daily trip between Kunsan and Misawa, the risk of having only one station at Misawa could be minimized.

#### Engines.

The biggest impact of decentralization will be on engines. PACAF has established one of the most complete engine repair facilities in the air force, and it will not be duplicated at the forward bases. The PLSC's authoriza-

tion to perform depot level overhaul of augmentors and to heat-treat hot section components will be lost once repair returns to the units. More important from the warfighting standpoint is the loss of engine authorizations. Because of the "queen bee" centralized repair, PACAF was authorized additional spare engines to cover transportation and handling. These additional spares frequently enabled the PLSC to provide PACAF units with many times the number of serviceable spares that CONUS units were able to generate. The impact of decentralization on spares authorizations is provided below (50:atch 2).

TABLE 4

PACAF Engine Authorizations

<u>Engine</u>	<u>Current</u>	<u>Decentralized</u>	<u>Difference</u>
J79-15	12	8	- 4
J79-17	51	32	-19
TF-34	11	6	- 5
F100-100	43	26	-17
F100-200	25	17	- 8
F110-100	<u>12</u>	<u>7</u>	<u>-5</u>
Total	154	96	-58

Support Center Pacific.

One of the biggest concerns with decentralization of the PLSC is the potential of losing the Support Center Pacific. As mentioned previously, the SCP depends on the PLSC's test equipment to perform the final serviceability

checks on the parts they repair. Of the 2545 LRUs and SRUs repaired by the SCP in FY86, 1642 or 64% had to be tested on PLSC equipment. In addition 95% of the 1300 line items repaired by the SCP are PLSC managed. In the absence of the PLSC, a separate asset management system would have to be established to record, ship, handle and store the parts. Low demand items which the SCP repairs today, because they are conveniently located with the PLSC, will no longer warrant being sent to the SCP.

On the positive side, over 50% of the items repaired by the PLSC are for the F-15. Since at least one F-15 AIS will remain at Kadena during a contingency, the SCP interface can be maintained. This will allow the SCP to buy test packages for the PK-1000 which would enable them to test the units they are unable to do now (1:4).

Currently, as much as one-third of the SCP's workload would vanish with the PLSC. This could easily be offset by integrating work from the KC-135, E-3A AWACS, and MAC aircraft stationed at Kadena into the SCP repair system.

The easiest and most economical method of retaining SCP capability is by retaining a scaled down version of the PLSC asset management system in Kadena's 313th Supply Squadron. This section would receive items from the bases, track them through the SCP repair, and return them to the

base that shipped them. This is a less flexible and slightly more cumbersome system than currently used, but it will ensure the retention of the SCP's responsive repair capability.

Summary.

Over the years PACAF has defended its centralized maintenance concept based on its immunity from attack, savings in manpower and equipment, reduction in mobility requirements, and reduction in the number of Korean short tours. On the basis of facts revealed by this study, the efficiencies envisioned for centralized repair have not materialized.

As a result, costs to return intermediate maintenance back to the PACAF units is surprisingly small. The \$21 million of facilities requirements generated by decentralization is offset by the \$22.5 million of programmed PLSC facilities which can be canceled, although a considerable re-design and reprogramming effort is required. Most test equipment is available in sufficient quantities to fill unit authorizations.

In some areas there are actually savings. Manpower authorizations can be reduced by 119 personnel. The theater inventory of PLSC managed spare parts will reduce by nearly 12%. Engine spares will be reduced by 58 engines.

There are some costs, however. Readiness levels for spare engines will almost certainly be reduced by the loss of the 58 engine authorizations. Numbers of serviceable spares would most probably fall to the levels experienced in TAC and USAFE. However, in a resource constrained environment, where depot engine production is being reduced by fiscal constraints, it is probably inevitable that spares will be redistributed even if the PLSC remains.

An additional cost is the increase of 227 short-tours. Fortunately, a majority of the short-tour authorizations will go to F-16 units. Due to the rapidly growing number of CONUS-based F-16 personnel, this small increase can easily be absorbed.

The major impact will be on the depot repair capability of the Support Center Pacific. While some efficiencies will be lost, many SCP functions will be unaffected. Nearly 50% of SCP's workload is generated by units stationed at Kadena. Procedures can be established to allow assets to move from the shop directly to the SCP like they do now. The decision on whether the SCP should repair other assets generated by units at other locations must be made by PACAF and AFLC on the basis of cost and mission support improvements.

Regardless of the decision on these items, the extraordinary payoffs, which have already accrued from

having a structural engineer in the theater, more than justifies the SCP's existence. In addition, the recent assignment of a Combat Logistics Support Squadron, to complement the SCP's operation, provides an immediate wartime combat battle damage repair capability as well as a badly needed peacetime structural repair and depot modification capability.

There appear to be no issues that would prevent decentralization of PLSC repair

## CHAPTER VII

### A MAINTENANCE STRUCTURE FOR COMBAT

The Soviets and their surrogates pose a serious threat to the relatively small number of PACAF fighters facing them. To meet the threat, PACAF forces must be mobile and flexible, able to deploy rapidly throughout the vast Pacific to serve as the first line of defense for a wide variety of contingencies ranging from conflict in Southwest Asia to a war with the Soviets. Wing maintenance organizations must be survivable, able to absorb an attack and continue to generate aircraft. They must be able to generate high numbers of sorties for the Korean scenario and high numbers of mission capable aircraft for the large force packages needed to penetrate Soviet defenses. Finally, they need to have the sustainability to continue the fight to a favorable conclusion. The structure which best meets these conditions is one that stresses maximum wing self-sufficiency supported by a logistics system that makes maximum use of in-theater industrial capacity to augment its support.

#### Wing Maintenance Structure.

The Rand corporation has studied wing maintenance structures extensively and have concluded that the COMO organization is far superior to a centralized wing organization when rapid aircraft turnaround times are required.

They report that, after conversion to COMO, wings experienced a 30% to 40% reduction in time between the aircraft landing and the commencement of work. This resulted in faster repair times and improvement in other measures of performance. There was a 12% improvement in meeting the scheduled first sorties of the day, a 45% improvement in turning aircraft into their next scheduled sortie, a 50% improvement in on-time sorties, and a 25% improvement in the number of aircraft repaired in less than three hours (61:10).

TAC Experience. The Tactical Air Command (TAC) has placed the focus of its maintenance on aircraft generation, and has decentralized maintenance more than any other command. The results, as reflected in figure 14, are impressive.

The COMO organization structure was described in Chapter II. Some of the features of COMO are:

- (1) The squadron-AMU team is responsible for its own scheduling rather than scheduling being a central wing function.
- (2) Each AMU has maintenance analysis responsibility for its squadron of aircraft, vice a central wing analysis.
- (3) The central Maintenance-Supply Liaison (MSL) function has been eliminated and replaced by AMU supply centers.
- (4) The AMU has a supply computer terminal which provides immediate notification of part availability.



## MC TRENDS: TAC, SAC, PACAF AND USAFE

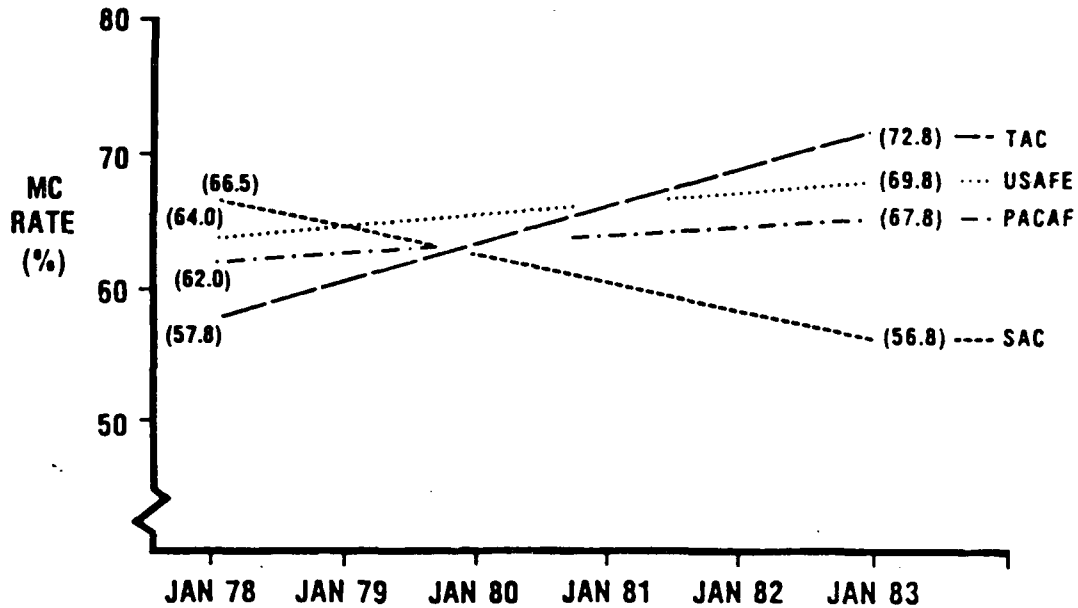


Figure 14 - Mission Capable Trends.

Source: Aerospace vehicle inventory and utilization reporting system (AVISURS).

(5) Pilot debriefing is done by the AMU rather than a central debriefing function.

(6) A crew chief is assigned to each aircraft, and is responsible for only that aircraft.

(7) The central "job control" function is replaced by a maintenance command center (MACC). The AMU has responsibility and authority over all resources needed to generate its aircraft.

(8) Units work a basic two-shift maintenance schedule instead of a three-shift. Increased supervision is assigned to the second shift.

(9) Identification to a particular flying squadron is extended beyond the AMU to all functions responsible for flightline support. For example, avionics technicians are divided into teams which are responsible for supporting a particular AMU/fighter squadron, and the Aerospace Ground Equipment Branch is divided into individual production units responsible for maintaining, servicing and delivering ground support equipment for its designated squadron of aircraft.

The TAC emphasis is on individual responsibility and authority. Production units are divided so that they can be measured meaningfully and so that individuals who are responsible have the authority and resources necessary to carry out that responsibility. Maximum emphasis is placed on individual and unit pride and competition. The results are shown dramatically in figure 15.

COSO. Perhaps the organizational enhancement that has helped TAC maintenance more than any other is the Combat Oriented Supply System. Instead of dealing with a central hierarchy which responded to every activity on the base from the gym to the civil engineer, COSO dedicates a supply function to support of aircraft maintenance.

## PERCENT CHANGE IN UTILIZATION RATES

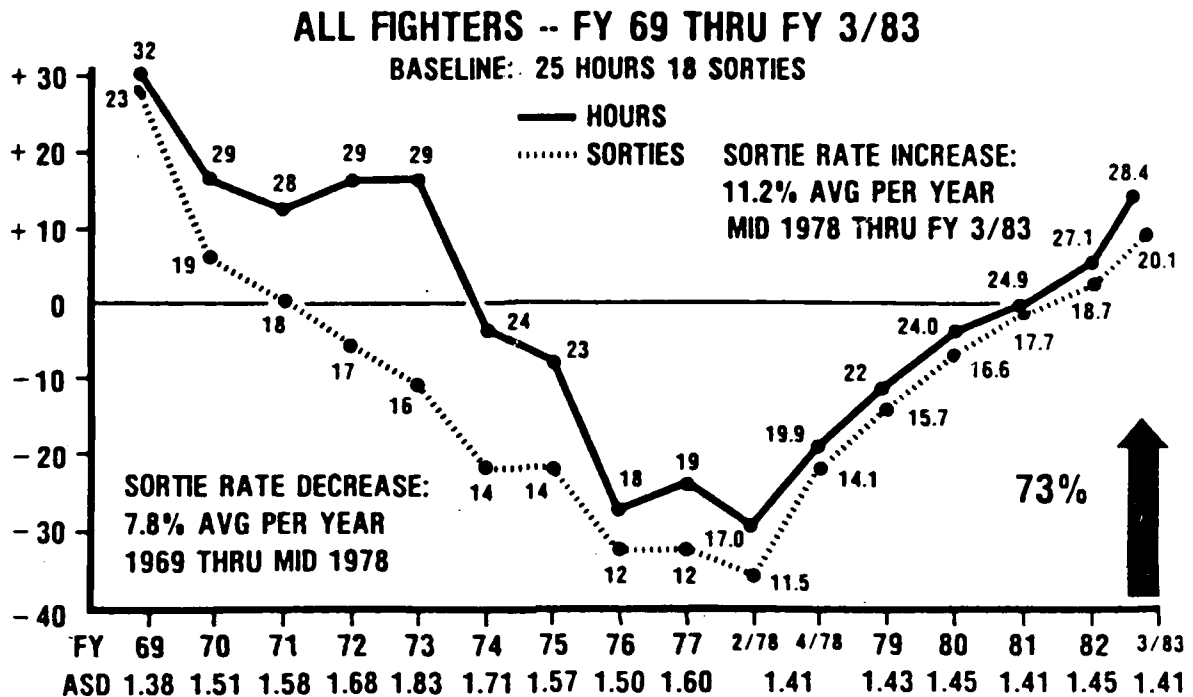


Figure 15 -- Sortie utilization rate improvement after implementation of COMO.

Source: TAC Senior Leader's Course

Under COSO aircraft parts are moved to the flight-line and placed in the aircraft parts store. Avionics components are placed in the parts service center adjacent to the avionics repair shops. The AMU supply function, which is given its own computer terminal, has instant visibility and can tell the mechanic if the part is available. If it is, the mechanic frequently has the part in his hand and is installing it in less than 10 minutes. Contrast this to the previous situation, where delivery delays were so frequent

## COSO AIRCRAFT PARTS

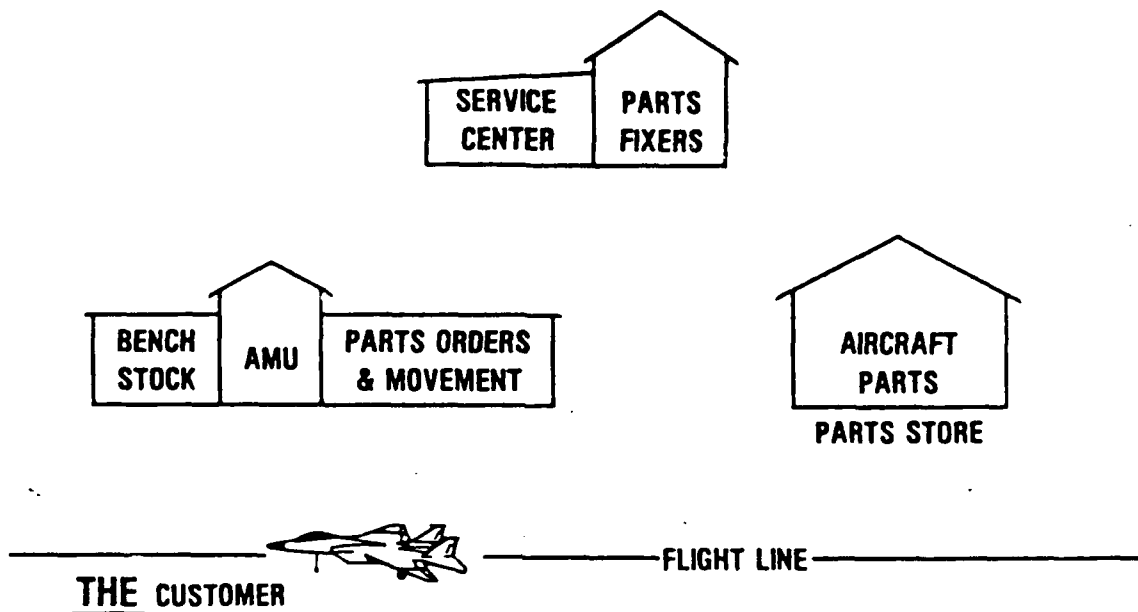


Figure 16 -- Combat Oriented Supply Organization.

that mechanics were routinely pulled off the aircraft and sent to other jobs once a part was ordered. The efficiencies are obvious.

Equally important, but seldom emphasized, is the impact on avionics repair times. By having necessary repair parts immediately available, avionics technicians can leave the part on the repair bench, get the part, install it and resume testing. Previously, the technician had to order the part, tag all of the disassembled hardware, secure it in packages, and remove it from the test bench to start work on

another component. When the part was received, it was scheduled back into work for whatever technician was available. He had to replace the component part and resume troubleshooting without the benefit of knowing exactly what had been done before. Delays and duplication of effort were frequent occurrences.

PACAF has only partially implemented COSO. In spite of the obvious advantages to maintenance, many bases do not have a functioning flightline parts store. The bases that do, have only partially realized its potential, because AMUs do not have remote terminals. Therefore, PACAF flightlines still go through the cumbersome procedure of ordering the part from the AMU supply section, which, in turn, has to order the part from a supply demand processing function. Mechanics are allowed to go to the flightline parts store to pick up parts, but delays in finding out whether parts are available are nearly as frequent as under the previous system, and mechanics have often started another job by the time they find the part is available. To improve supply support to maintenance, PACAF needs to place computer remotes in AMU supply sections and fully implement COSO.

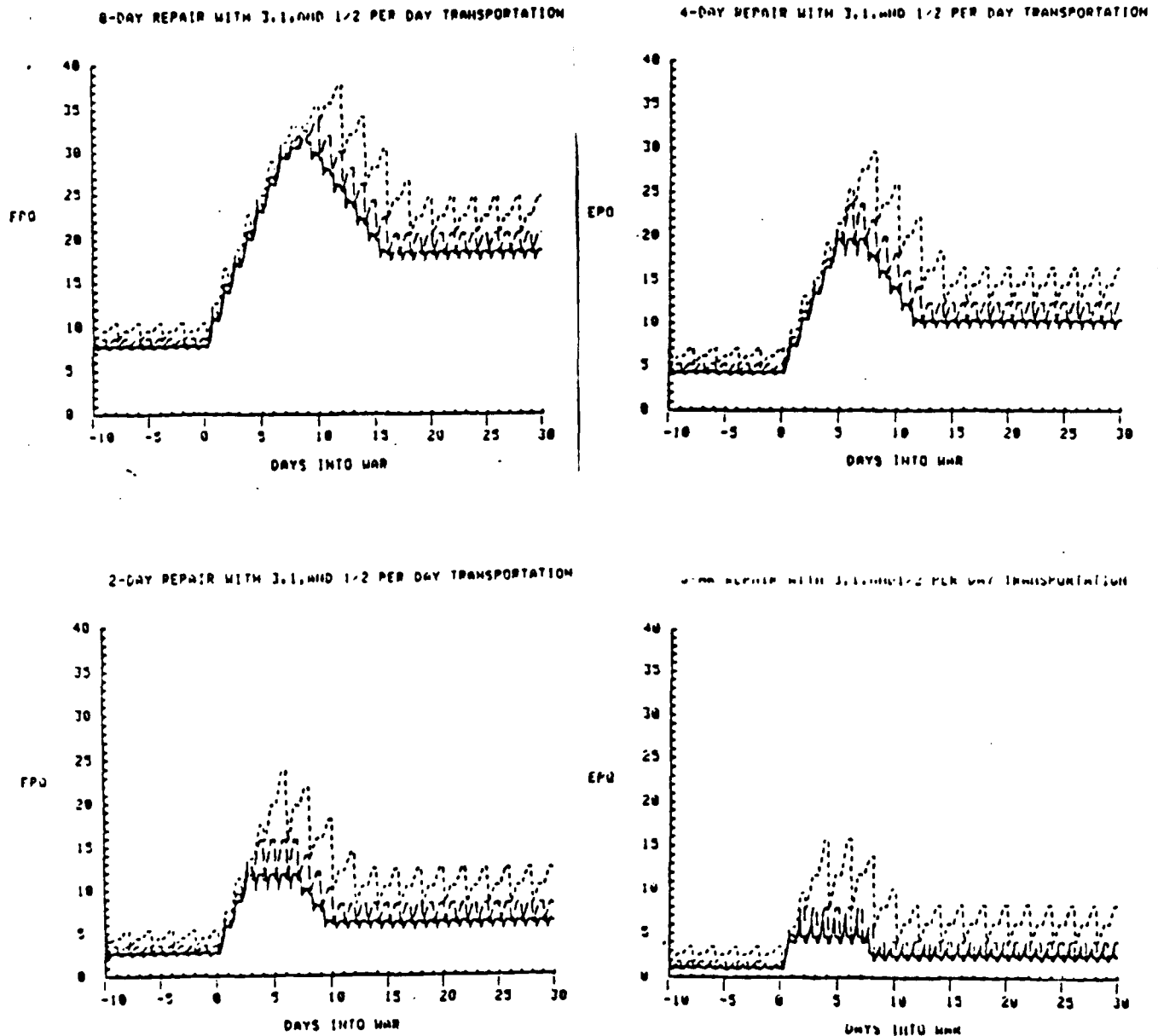
Full Intermediate Repair Capability. While studying the benefits of PDS, the PACAF Operations Analysis Office found that the greatest benefit could be gained from a combination of increased transportation frequency and reduced

repair times. Using a simulation model for a problem item that breaks at a rate of 14 per 1000 flying hours, expected backorders were much more responsive to changes in repair times than they were to frequency of transportation (figure 16). For an 8 day repair cycle, backorders ranged from 30, for twice daily transportation, to 37, for 3 day transportation. Conversely, for 4 day repair, backorders ranged from 19, for twice a day delivery, to 30, for 3 day delivery (52:VI).

The study clearly made the point that "bad actor parts" would determine the end impact on aircraft availability. By bad actor, the study referred to parts with high variability as discussed earlier. Those parts which suddenly have a high surge in demand have a major impact on PACAF aircraft availability, because the system is not responsive enough to react in a timely manner. Delays in getting the repairable parts back to the PLSC, the loss of priority because of competing demands from several wings, and an inevitable "business as usual" mentality, all prevent the parts being repaired and returned in a timely manner.

The best way to eliminate these delays is to give the units their own repair capability. This immediately eliminates from two to eight days of transportation time, plus the time and manpower involved in processing, packaging and moving the part through the base system to and from

FIGURE 16 -- Impact of Transportation and Repair on Expected Backorders.



transportation. In addition, base repair is much more responsive to unit priorities. If a particular item is grounding aircraft, it can immediately be put into repair ahead of all other items. With the sense of unit identity now prevalent in the intermediate maintenance shops, their sense of urgency for getting the aircraft fixed and in the air is nearly as great as the flightline mechanic's.

The recent TAC CORONET WARRIOR exercise provides a perfect example. The 1st TFW was tasked to mobilize, set up in a deployed configuration, and exist for 30 days using only parts from their war readiness spares kit (WRSK) and their deployed repair capability. They were authorized to use wartime procedures and use initiative to overcome logistics shortfalls.

The F-15 radar 039 and 081 processors failed at rates five times greater than predicted (refer to figure 17). This would normally be expected to result in significant numbers of not mission capable aircraft. Instead the unit repaired the items five times faster than predicted and used their technical knowledge to repair items beyond their normal repair authority. Eleven inertial measurement units (IMUs) had internal failures which normally required their return to the depot. Since the mission impact was so great, the avionics shop opened the IMUs and found that the same resistor failed in each one. The shop found the resistor in



# CORONET WARRIOR

## REPAIR CYCLE PRODUCTIVITY

COMPONENT	ACTUAL FAILURES	UNITS REPAIRED		DAYS TO REPAIR		UNITS NOT REPAIRABLE	
		PRED	ACTUAL	PRED	ACTUAL	PRED	ACTUAL
039 PROCESSOR	51	8	49	4	1.0	3	0
081 PROCESSOR	45	9	43	6	1.0	3	1
IMU	32	14	29	5	3.1	11	3
BAND 2 AMP	27	42	23	6	4.2	2	0
BAND 2 OSC	24	41	5	6	3.1	2	0
ALR 56 REC	24	2	15	6	5.1	2	0
011 TRANS	22	5	20	4	1.8	1	0
IFF R/T UNIT	21	12	15	5	1.1	1	1
042 PROCESSOR	16	3	14	5	1.9	1	1
031 RADAR ANT	14	12	14	5	1.3	0	0
AIC	17	N/A	12	N/A	0.9	15	3

Figure 17 -- Coronet Warrior

bench stock, replaced it, and returned all 11 IMUs back to service. This is the kind of flexibility needed to fight a war. Under the centralized system in PACAF, many of the units would not even have left the base to go to repair in the time it took the 1st TFW to return the serviceable item to the aircraft.

#### Survivability.

The price of gaining this increase in combat generation capability is an increase in vulnerability. As supplies and critical repair capability are moved closer to the flightline, their combat risk increases. It is important that these resources be protected by dispersing them and placing them in hardened facilities or aircraft shelters. In the absence of a secure, readily available source of support, the loss of supplies and repair capability would quickly shut down a wing.

This is where PDS pays off. With PDS, the risk of placing critical repair capability at forward bases is minimized. The dedicated communication and frequent transportation capabilities of PDS would enable PACAF to quickly set up a buddy system in which one or more bases could serve as the supply and repair source for a unit that had lost its capability. As the number of F-16 units increases, this capability becomes increasingly valuable. PACAF's resource management centers (RMCs), discussed in chapter III, provide

a ready made system to implement these emergency procedures. As the logistics arm of the air component commander's staff, the RMC has theater wide visibility of parts and repair capability, and has the authority to direct logistics movements to maximize theater combat capability.

#### Mobility.

One of the major selling points for centralized intermediate repair is that it reduces airlift requirements. While there are undeniably some savings, the reductions are not as significant as anticipated. The major airlift shortfall occurs during the deployment period. Many of the savings accrued with the PLSC operation are for repair capabilities which are normally deployed with follow-on support packages at D+30, and fall outside of this critical period (50). Equipment for major intermediate level engine overhaul and F-16 avionics test stations are two major examples. In addition, as mentioned previously, many items of conventional avionics test benches for the F-4 are required so frequently for test and alignment that they were authorized both at the unit and at the PLSC. These items were already deployed in support packages.

The greatest savings occurs for PACAF F-15s. Normally large avionics test stations are deployed with the initial support package. By eliminating the requirement to move these stations, PACAF reduces the airlift requirement

for a squadron of F-15s from 14 C-141Bs down to 12 C-141Bs. The second major advantage purported for the PLSC was that units could deploy to the theater and expect support from the PLSC from day 1, thus eliminating the disruption in repair capability that would result from the requirement to tear down and then re-set-up their intermediate test equipment. This would work, except that the PLSC resupply is dependent on the same airlift aircraft that are engaged in deploying the units. There is a very great likelihood that movement of cargo to and from the PLSC will be interrupted for the duration of the initial deployment period.

The PLSC concept also breaks down when PACAF aircraft are required to deploy out of their current operating area. The PLSC pipeline works reasonably well when every supported unit is within range of a single C130 flight. However, as seen when Misawa was added to the PLSC system, it quickly becomes unresponsive when cargo has to be transferred to another aircraft. Because of the transfer of cargo at Yokota, it takes 4 to 5 days to move parts from the PLSC shop to the Misawa flightline.

Once aircraft deploy out of the PLSC's relatively confined operating area in Northeast Asia, the system is simply not responsive enough to support combat operations. Units deploying to Southeast or Southwest Asia would have to take most intermediate maintenance with them.

This creates a problem. One of the lessons we learned from the Vietnam conflict is that we need to operate day-to-day like we plan to fight. Since the PACAF focus is on Korea and the Soviet threat in Northeast Asia, little emphasis has been placed on developing the PLSC's capability to mobilize its personnel and equipment. Items like generators and air-conditioners are not available in sufficient numbers to support bare base operations.

Even if the PLSC were tasked for mobility, it would require units to reorganize in the middle of a contingency. Wings that are used to operating on a remove and replace maintenance concept would suddenly be required to develop new procedures. While this is not particularly difficult, it is preferable to have units that are experienced in operating this way day to day, and which have developed the procedures, personal relationships, and experience needed to maximize their combat efficiency. Therefore, while reducing total airlift is desirable, flexible, responsive operations are more important. Repair at unit level is the right answer.

#### Sustainability.

The major focus of this study has been devoted to the PLSC and the ability of PACAF's centralized logistics system to meet the current threat. While this is the most

critical aspect of combat support, there are other initiatives which can improve sustainability.

Aircraft Battle Damage Repair. Studies of Vietnam, the 1967 and 1973 Arab-Israeli conflicts, and the Falklands War have all pointed out how essential good aircraft battle damage repair (ABDR) will be to sustaining combat capability (64:160). PACAF is developing unit ABDR teams with special tools and supplies, but this is not enough. For example, units do not even have the tools and adapters to do wing changes. When the F-15 wing rib problem surfaced in 1984, there was only one set of tools and adapters in the entire Air Force. This is clearly a product of a peacetime mentality. Stocks of wings, and other flight control surfaces should be available in the forward theater for combat damage repair. As pointed out previously, the forward warehouse feature of PDS should stock these critical battle damage repair parts.

In addition, provisions should be made to use in-theater contractors in the heavy ABDR role. Contractors such as Korean Air, Philippine Airline, and Mitsubishi Aircraft have excellent facilities and skilled workforces capable and willing to assume this role (66:47-49).

Ishikawajima-Harima Heavy Industries, Japan, and Samsung Precision Industries Company, Korea, produce engine components under contract to General Electric and Pratt & Whitney

Aircraft. They would be excellent sources for spare parts in the event of a conflict.

The Support Center Pacific's combat support role cannot be overlooked. Its circuit card repair capability, metal processing, and structural engineering capability provide enhanced support to units in the theater. This capability significantly improves wartime logistics support, and should be retained if at all possible.

## CHAPTER VIII

### SUMMARY AND CONCLUSIONS

The Pacific Air Forces have successfully relied on a theater-unique maintenance system since the late 70's. Wing maintenance is designed around the Combat Oriented Maintenance Organization used by TAC, but has not adopted many of the decentralization programs that the COMO philosophy is based on. More importantly, the majority of the high technology intermediate level maintenance has been removed from the wings and centralized at the PACAF Logistics Support Center on Kadena AB, Okinawa.

This study has found that many of the premises on which the Centralized Logistics System was founded no longer apply. Central repair was justified based on the mid 1970's Korean threat, and made sense in that environment. Since then, things have changed.

Soviet access to Cam Rahn Bay has given them a theater-wide power projection capability. Kadena AB is well within range of bombers and submarines from Cam Rahn Bay and bases in Manchuria and Kamchatka. Kadena AB is a tempting target with its F-15s, E-3As, KC-135s, dual runways, major MAC terminal and PLSC. Thus the PLSC can no longer be viewed as being located in a safe haven.



The large consolidated repair center is also not as efficient as envisioned. By returning repair capability to the wings, PACAF will be authorized 58 fewer engines, 12% fewer end item aircraft parts (LRUs), and 119 fewer manpower authorizations. In addition, centralized repair has prevented PACAF from realizing much of the efficiency and responsiveness inherent in TAC's COMO.

#### Conclusion.

There is no doubt that both PACAF's Centralized Logistics System and TAC's enhanced COMO will work for PACAF. Both systems have their advantages and disadvantages. For combat, however, when units are subject to air-field attacks, interruption of resupply, and other stresses of combat, the unit with the most independent capability is likely to adjust the best (39:4).

The centralized repair concept leaves no room for the individual initiative demonstrated during "Coronet Warrior". If the unit does not possess the basic repair capability, it is nearly impossible to improvise and devise an effective work-around repair. In addition, transportation delays to and from the PLSC prevent the responsiveness that allowed the 1st TFW to repair forty-nine O39 processors when only 8 were projected to fail (74). If these units had to be shipped to a central repair facility, many aircraft would have been grounded. When these factors are combined with

the risk inherent in losing total theater repair capability with an attack on the PLSC, there is no question but that intermediate repair should be returned to the units.

The nucleus of the PACAF maintenance structure should be based on a full implementation of COMO. The first step is to return full intermediate repair to the units as soon as facilities, tools, and personnel can be made available. As noted in Chapter VI, most of the required resources are already available.

PACAF should follow TAC's lead on those programs that have already proven successful. Beyond returning maintenance capability to the units, a full implementation of the COSO is the single biggest improvement PACAF could make.

Although both of these changes will dramatically improve the flexibility and responsiveness of the PACAF maintenance structure, they will also increase the potential for combat loss. As aircraft parts supplies and repair capability move closer to the flightline, they become easier to target, and more subject to collateral damage. It is essential, therefore, that these assets be protected by as much dispersal and hardened protective sheltering as practical.

The PACAF Distribution System is the feature that ties the system together and provides the necessary flexibility to meet the unexpected disasters of war. The three

PDS elements of dedicated logistics communications, small responsive aircraft, and an AFLC warehouse stocked with appropriate aircraft parts all serve as combat force multipliers. With PDS, the Air Component Commander has the means to move assets between bases to achieve the highest number of combat ready aircraft. PDS relieves the theater commander from having to make the decision on whether to move a full C130 load of supplies or pick up a handful of aircraft parts that may repair three more aircraft. With PACAF's current initiative to disband the PLSC, and with the current budget limitations, PDS is in danger of being lost. This would be a mistake, because, for the cost, PDS adds logistics flexibility that will really pay off in combat.

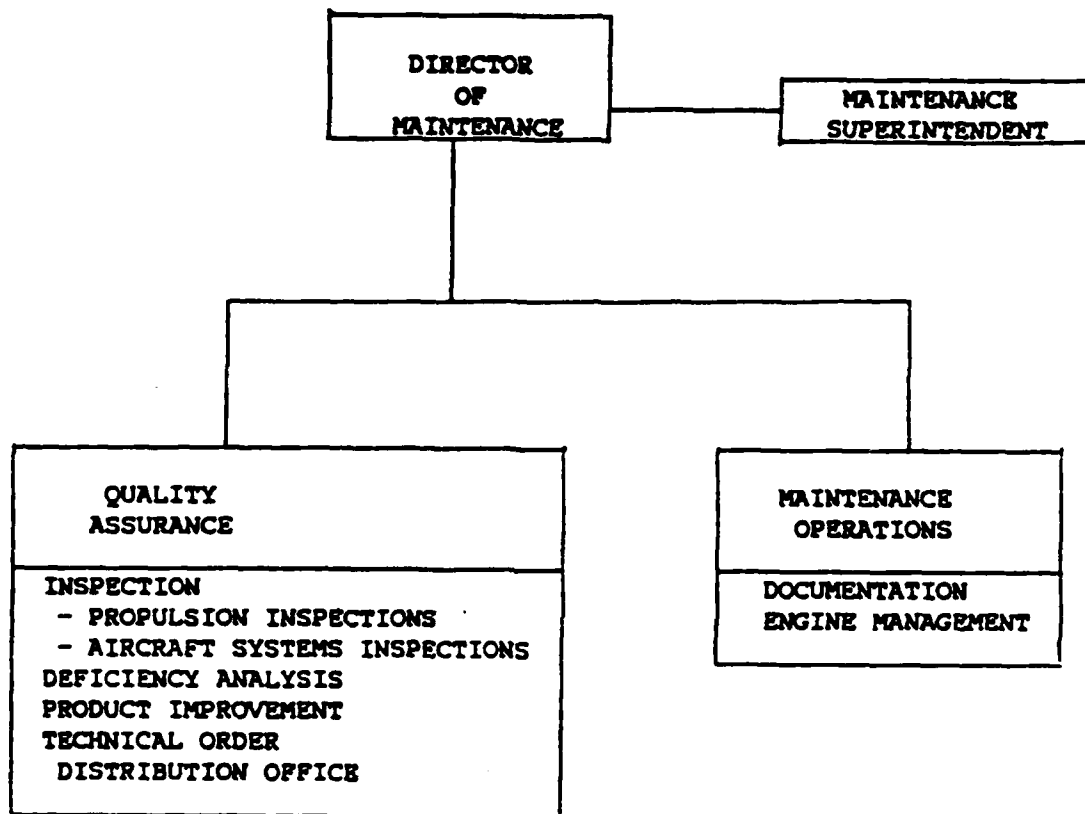
Finally, PACAF needs to be aggressive in pursuing methods to shorten its long and fragile logistics pipeline. The in-theater, AFLC depot capability, represented by the Support Center Pacific, is a good first step. However, AFLC and PACAF need to explore more ways of using the industrial capacity of our allies in the theater to provide wartime support for U.S. forces.

PACAF has led the way by identifying potential sources. It has encouraged AFLC to issue contracts for engine component repair to Ishikawajima-Harima Heavy Industries in Japan, and Samsung Precision Industries in Korea, but this is only scratching the surface of the potential

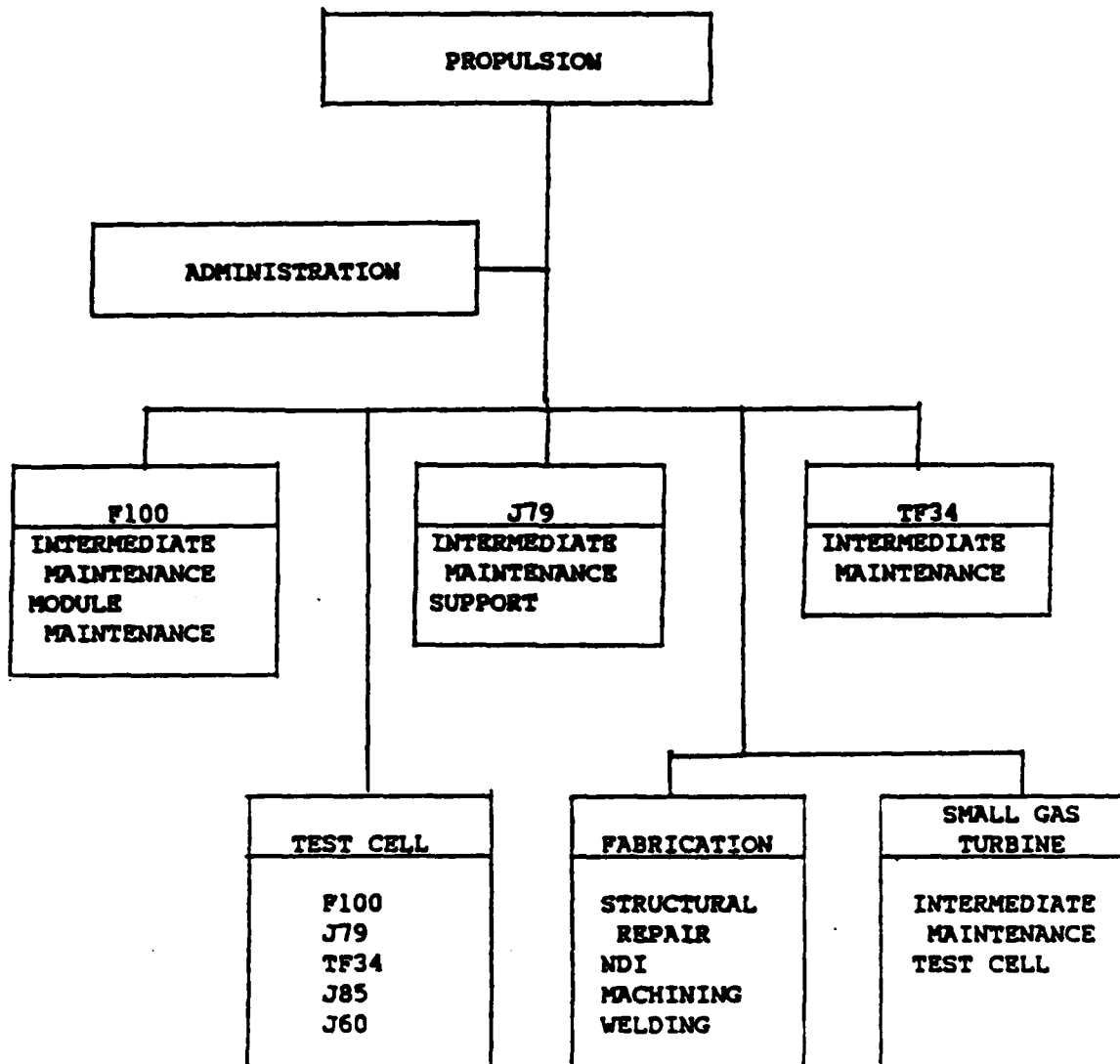
support available. For example, Mitsubishi Aircraft manufactures the Japanese F-15, and should be a ready source of parts and battle damage repair for that aircraft.

Many of the recommendations of this study are already being implemented by PACAF. Movement of repair to the units has begun and should be completed in 1989, but this is only the first step. The system must be designed for survivability, and this means allocating the money needed for hardening critical maintenance facilities, and on a priority basis. It also means fighting for PDS and getting the dedicated communication and aircraft that will ensure logistics can respond to the disasters and the "fog of war." With this as a base, supported by a network of in-theater and CONUS depots, PACAF will have an aircraft maintenance structure to reckon with.

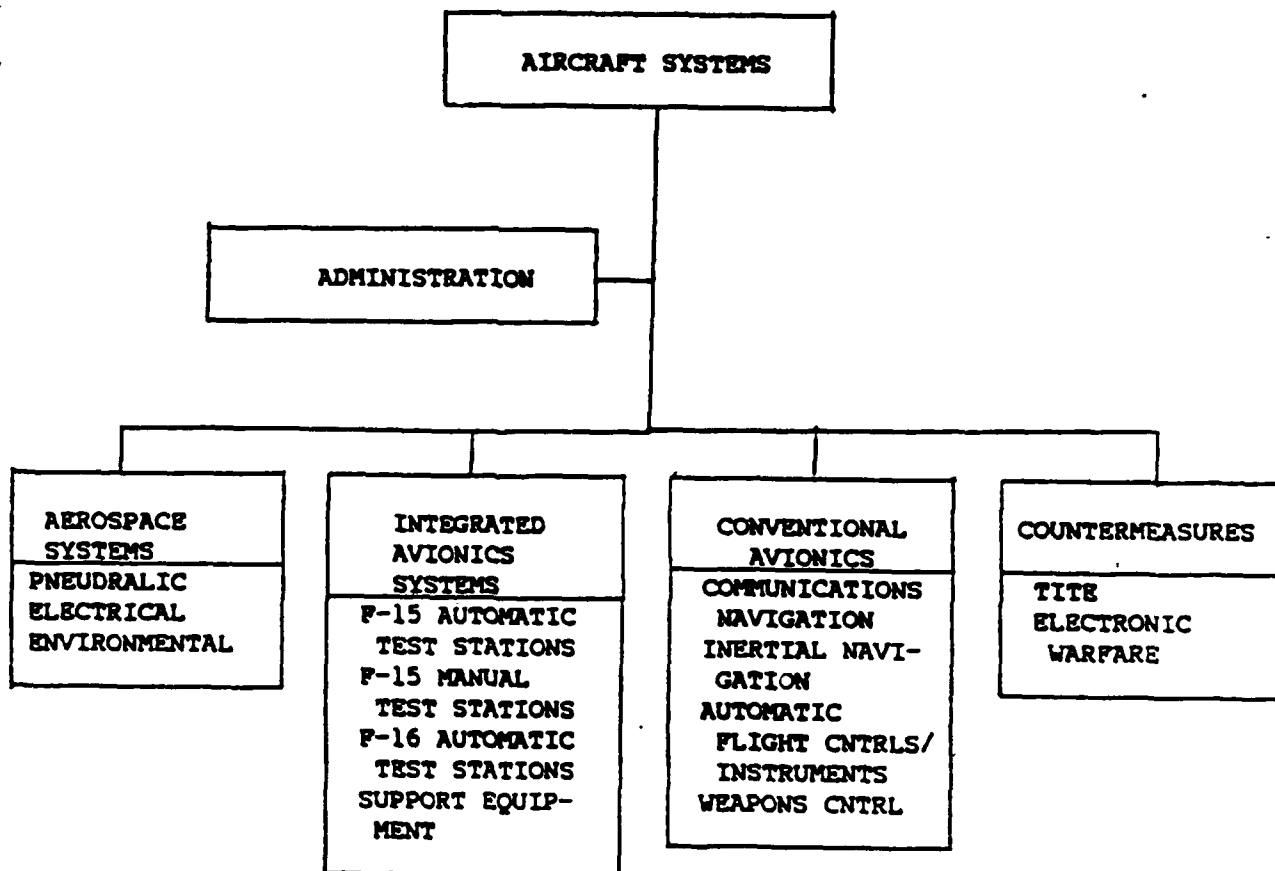
APPENDIX A -- PLSC DIRECTORATE OF MAINTENANCE



APPENDIX A.2 -- PLSC PROPULSION DIVISION



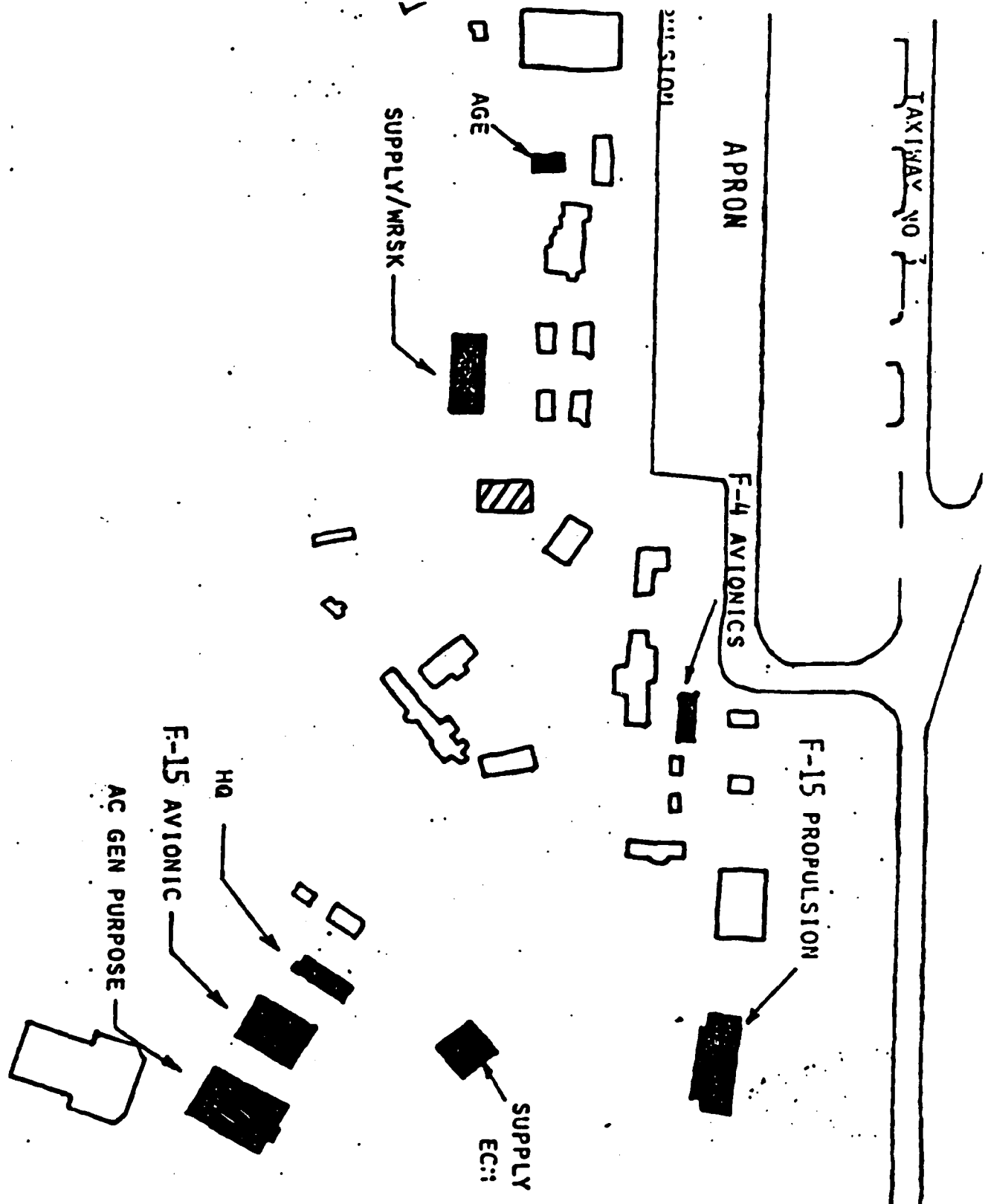
APPENDIX A.3 -- PLSC AIRCRAFT SYSTEMS DIVISION



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# APPENDIX C -- PLSC SHOP LOCATION



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